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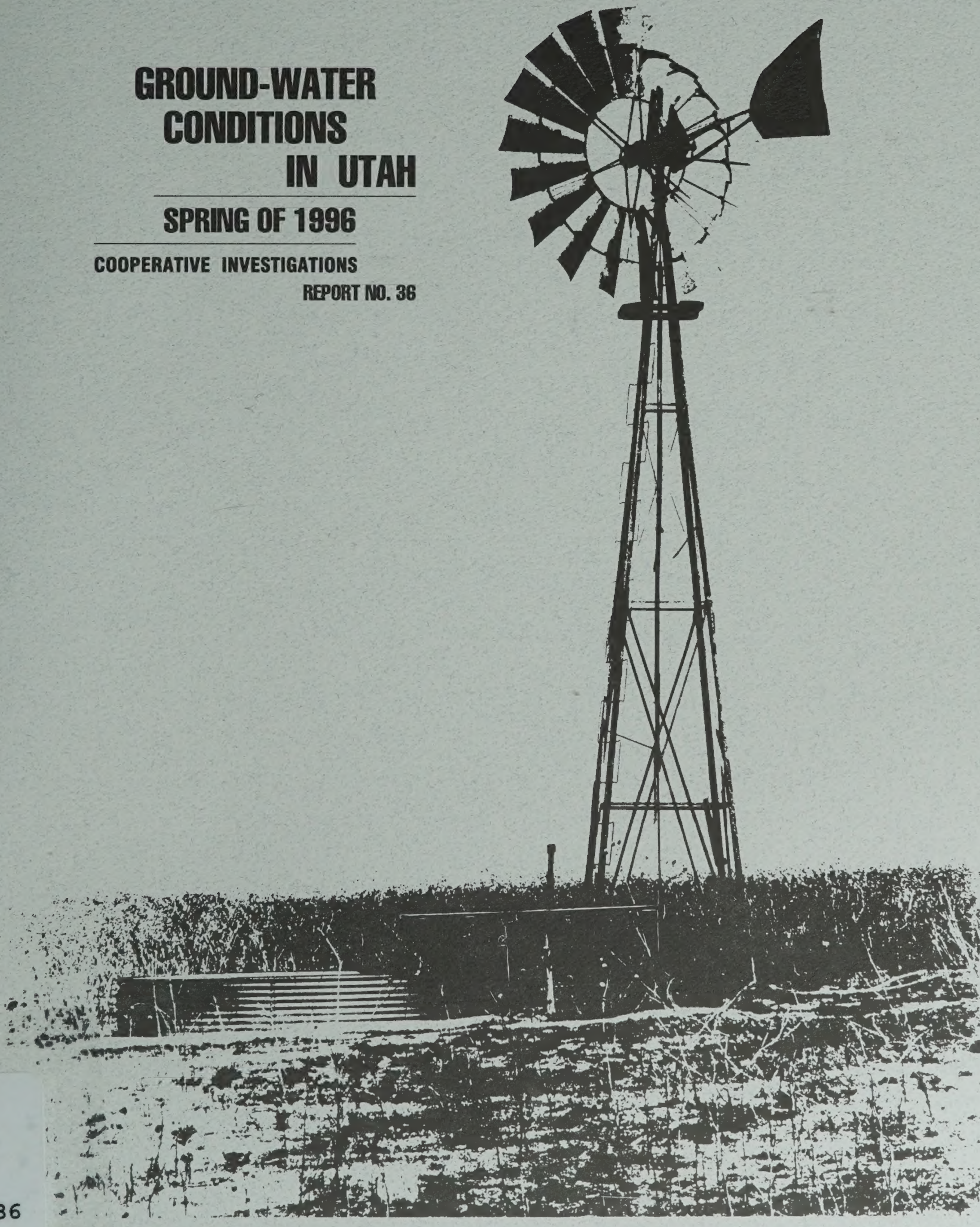

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GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1996

By

J.I. Steiger, S.J. Gerner, and others

U.S. Geological Survey

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Cooperative Investigations Report Number 36

1996

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CONVERSION FACTORS

Multiply	By	To obtain
acre-foot	1,233	cubic meter
foot	0.3048	meter
inch	25.4	millimeter
mile	1.609	kilometer

Chemical concentration is reported only in metric units—milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

DEFINITION OF TERMS

Acre-foot (acre-ft)—The quantity of water required to cover one acre to a depth of one foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Aquifer—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.

Dissolved—Material in a representative water sample that passes through a 0.45–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

Land-surface datum (lsd)—A datum plane that is approximately at land surface at each ground-water observation well.

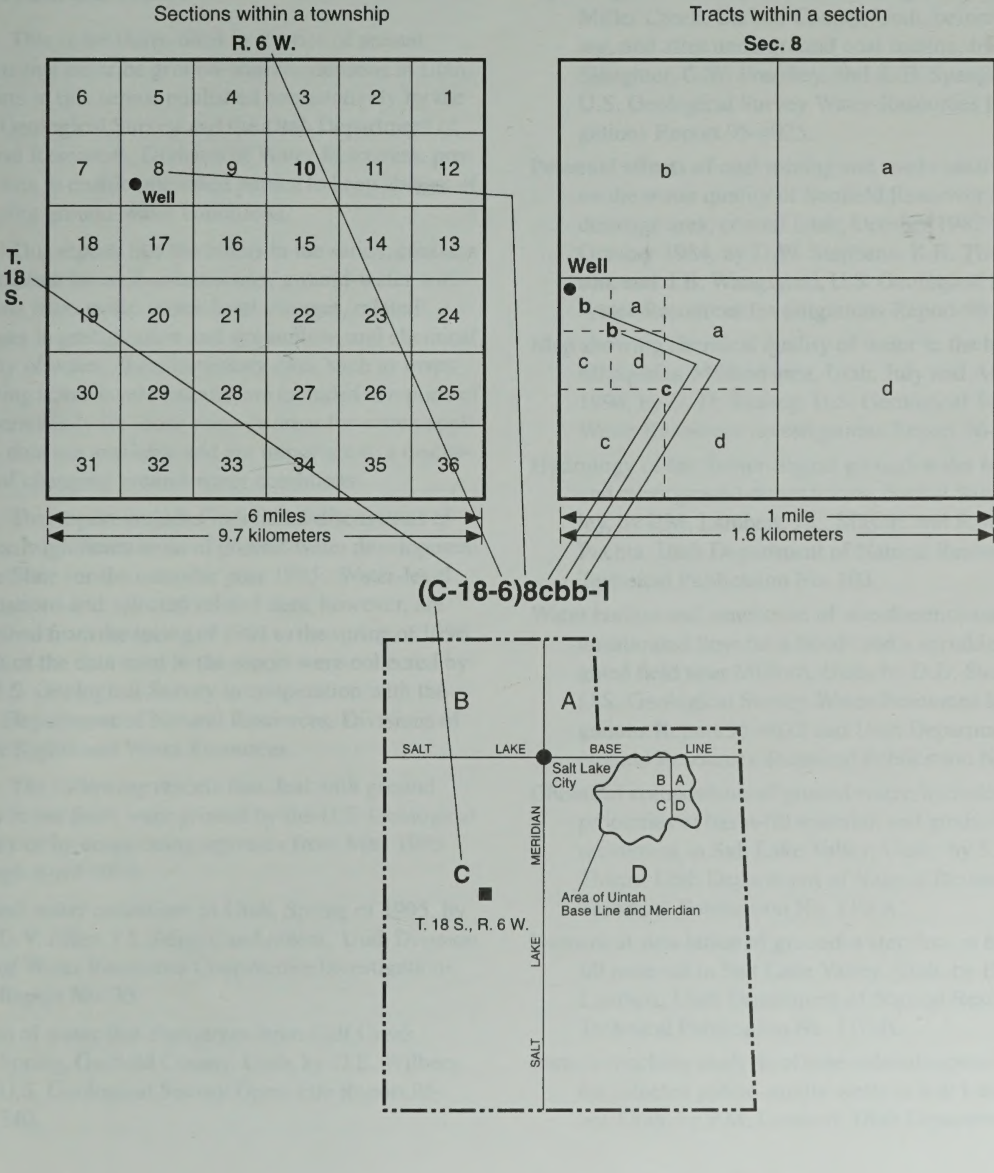
Milligrams per liter (mg/L)—A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water.

Specific conductance—A measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

Cumulative departure from average annual precipitation—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or greater-than-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward-trending graph for a period of years represents a period of generally less-than-average precipitation, which commonly causes and correlates with declining water levels in wells. Likewise, a generally upward-trending graph for a period of years represents a period of greater-than-average precipitation, which commonly causes and correlates with rising water levels in wells. However, increases or decreases in withdrawals of ground water from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.

WELL-NUMBERING SYSTEM

The well-numbering system used in Utah is based on the Bureau of Land Management's system of land subdivision. The well-numbering system is familiar to most water users in Utah, and the well number shows the location of the well by quadrant, township, range, section, and position within the section. Well numbers for most of the State are derived from the Salt Lake Base Line and the Salt Lake Meridian. Well numbers for wells located inside the area of the Uintah Base Line and Meridian are designated in the same manner as those based on the Salt Lake Base Line and Meridian, with the addition of the "U" preceding the parentheses. The numbering system is illustrated below.



GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1996

By

J.I. Steiger, S.J. Gerner, and others

U.S. Geological Survey

INTRODUCTION

This is the thirty-third in a series of annual reports that describe ground-water conditions in Utah. Reports in this series, published cooperatively by the U.S. Geological Survey and the Utah Department of Natural Resources, Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals from wells, water-level changes, related changes in precipitation and streamflow, and chemical quality of water. Supplementary data, such as maps showing water-level contours, are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

This report includes individual discussions of selected significant areas of ground-water development in the State for the calendar year 1995. Water-level fluctuations and selected related data, however, are described from the spring of 1991 to the spring of 1996. Much of the data used in the report were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Divisions of Water Rights and Water Resources.

The following reports that deal with ground water in the State were printed by the U.S. Geological Survey or by cooperating agencies from May 1995 through April 1996:

Ground-water conditions in Utah, Spring of 1995, by D.V. Allen, J.I. Steiger, and others, Utah Division of Water Resources Cooperative Investigations Report No. 35.

Origin of water that discharges from Calf Creek Spring, Garfield County, Utah, by D.E. Wilberg, U.S. Geological Survey Open-File Report 95-340.

Hydrology of the North Fork of the Right Fork of Miller Creek, Carbon County, Utah, before, during, and after underground coal mining, by C.B. Slaughter, G.W. Freethey, and L.E. Spangler, U.S. Geological Survey Water-Resources Investigations Report 95-4025.

Potential effects of coal mining and road construction on the water quality of Scofield Reservoir and its drainage area, central Utah, October 1982 to October 1984, by D.W. Stephens, K.R. Thompson, and J.B. Wangsgard, U.S. Geological Survey Water-Resources Investigations Report 96-4020.

Map showing chemical quality of water in the basin-fill aquifer, Milford area, Utah, July and August 1994, by D. D. Susong, U.S. Geological Survey Water-Resources Investigations Report 96-4057.

Hydrology of the Sevier-Sigurd ground-water basin and other ground-water basins, central Sevier Valley, by P.M. Lambert, J.L. Mason, and R.W. Puchta, Utah Department of Natural Resources Technical Publication No. 103.

Water budget and simulation of one-dimensional unsaturated flow for a flood- and a sprinkler-irrigated field near Milford, Utah, by D.D. Susong, U.S. Geological Survey Water-Resources Investigations Report 95-4072 and Utah Department of Natural Resources Technical Publication No. 109.

Chemical composition of ground water, hydrologic properties of basin-fill material, and ground-water movement in Salt Lake Valley, Utah, by S.A. Thiros, Utah Department of Natural Resources Technical Publication No. 110-A.

Numerical simulation of ground-water flow in basin-fill material in Salt Lake Valley, Utah, by P.M. Lambert, Utah Department of Natural Resources Technical Publication No. 110-B.

Particle-tracking analysis of time-related capture zones for selected public-supply wells in Salt Lake Valley, Utah, by P.M. Lambert, Utah Department of

Natural Resources Technical Publication No. 110-C.

Hydrology and simulation of ground-water flow in southern Utah and Goshen Valleys, Utah, by L.E. Brooks, and B.J. Stolp, Utah Department of Natural Resources Technical Publication No. 111.

Hydrology of Sanpete Valley, Sanpete and Juab Counties, Utah, and simulation of ground-water flow in the valley-fill aquifer, by D.E. Wilberg, and V.M. Heilweil, Utah Department of Natural Resources Technical Publication No. 113.

UTAH'S GROUND-WATER RESERVOIRS

Small amounts of ground water can be obtained from wells throughout much of Utah, but large amounts that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The areas of ground-water development discussed in this report are shown in figure 1 and listed in table 1. Relatively few wells outside of these areas yield large amounts of water of suitable chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah yield water from consolidated rock. Consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that penetrate consolidated rock are in the eastern and southern parts of the State in areas where water cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah yield water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. The largest yields are obtained from coarse materials that are sorted into deposits of uniform grain size. Most wells that yield water from unconsolidated deposits are in large intermountain basins that have been partly filled with rock material eroded from the adjacent mountains.

SUMMARY OF CONDITIONS

The total estimated withdrawal of water from wells in Utah during 1995 was about 732,000 acre-feet (table 2), which is about 201,000 acre-feet less than in 1994 and 110,000 acre-feet less than the average annual withdrawal for 1985-94 (table 3). The average annual withdrawal during 1991-95 was about 857,000 acre-feet, which is 31,000 acre-feet more than during the preceding 5-year period, 1986-90 (table 2).

Withdrawals in 1995 for four water-use categories: (1) irrigation, (2) industry, (3) public supply, and (4) domestic and stock, decreased from the 1994 totals. Withdrawals for irrigation were about 438,000 acre-feet (table 2), which is 144,000 acre-feet less than for 1994, and represent the largest decrease in the categories. Withdrawals for public supply decreased about 39,000 acre-feet from about 218,000 acre-feet in 1994 to an estimated 179,000 acre-feet in 1995. Withdrawals for industrial use were about 53,000 acre-feet, which is 13,000 acre-feet less than for 1994; and the 61,000 acre-feet withdrawn for domestic and stock use is 5,000 acre-feet less than the amount for 1994.

Ground-water withdrawals decreased from 1994 to 1995 in 14 of the areas of ground-water development referred to in this report (table 2). Withdrawals in Utah and Goshen Valley decreased about 37,000 acre-feet, the largest decrease of the ground-water development areas. Withdrawals remained the same in central Sevier Valley and increased about 1,000 acre-feet in the central Virgin River area. The 1995 withdrawals were less than the average annual withdrawals for 1985-94 in 12 of the areas. Average annual withdrawals during 1991-95 in 11 of the areas exceeded average annual withdrawals for the preceding 5-year period, 1986-90. In those 11 areas, the average difference is an increase of about 6,000 acre-feet for 1991-95 compared with 1986-90; in the remaining 5 areas, the average difference is a decrease of about 7,000 acre-feet.

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 1995 at 28 of 32 weather stations included in this report (National Oceanic and Atmospheric Administration, 1995) was greater than the long-term average. The largest positive departure from average in 1995 is the 9.17 inches greater than average recorded at Laketown, at the south end of Bear Lake, and the largest negative departure from average is the 2.28 inches recorded at Bluff in southeastern Utah. Average annual precipita-

tion during 1991-95 was more than for the preceding 5-year period, 1986-90, at 31 of the 32 weather stations. The average difference between the 5-year periods at those 31 stations is 2.09 inches.

Increased withdrawals during 1991-95, as compared with withdrawals during 1986-90, resulted in large areas of ground-water-level declines in nine of the areas of ground-water development in Utah. The maximum decline, nearly 27 feet, occurred in a well near Herriman in Salt Lake Valley. The areas where withdrawals were smaller during 1991-95, as compared with withdrawals during 1986-90, generally had water-level rises. Water levels rose in parts of all the significant areas except for the deep artesian aquifer in the Sevier Desert area. There were no water-level declines in Cache Valley, and only one decline in the central Sevier Valley area. The greatest water-level rise, almost 35 feet, was in northern Utah Valley, about 3 miles north of American Fork.

A total of 1,197 wells were constructed during 1995, as determined from reports by well drillers filed with the Utah Division of Water Rights (table 2). This is 13 less wells than were reported for 1994 and 20 more than were reported for 1993. Of the 1,197 wells constructed in 1995, 707 were for new appropriations of ground water and 46 were replacements wells. The remaining 444 wells include test and monitoring wells. In 1995, 181 large-diameter wells (12 inches or more) were constructed principally for withdrawal of water for public supply, irrigation, and industrial use.

Figure 1. Areas of ground-water development in Utah specifically referred to in this report.

Table 1. Areas of ground-water development in Utah specifically referred to in this report

Number in figure 1	Area	Principal types of water-bearing rocks
1	Grouse Creek Valley	Unconsolidated.
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated.
4	Malad-lower Bear River Valley	Unconsolidated.
5	Cache Valley	Do.
6	Bear Lake Valley	Do.
7	Upper Bear River Valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Park City area	Unconsolidated and consolidated.
12	Tooele Valley	Unconsolidated.
13	Rush Valley	Do.
14	Dugway area	Do.
	Skull Valley	Do.
	Old River Bed	Do.
15	Cedar Valley, Utah County	Do.
16	Utah and Goshen Valleys	Do.
17	Heber Valley	Do.
18	Duchesne River area	Unconsolidated and consolidated.
19	Vernal area	Do.
20	Sanpete Valley	Do.
21	Juab Valley	Unconsolidated.
22	Central Sevier Valley	Do.
23	Pahvant Valley	Unconsolidated and consolidated.
24	Sevier Desert	Unconsolidated.
25	Snake Valley	Do.
26	Milford area	Do.
27	Beaver Valley	Do.
28	Monticello area	Consolidated.
29	Spanish Valley	Unconsolidated and consolidated.
30	Blanding area	Consolidated.
31	Parowan Valley	Unconsolidated and consolidated.
32	Cedar Valley, Iron County	Unconsolidated.
33	Beryl-Enterprise area	Do.
34	Central Virgin River area	Unconsolidated and consolidated.
35	Upper Sevier Valleys	Unconsolidated.
36	Upper Fremont River Valley	Unconsolidated and consolidated.

Table 2. Number of wells constructed and withdrawal of water from wells in Utah

Number of wells constructed in 1995—Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes test wells and replacement wells.

Estimated withdrawals from wells—

1994 total: From Allen and others (1995, table 2).

1986-90 and 1991-95 average: Calculated from previous reports of this series.

	Number in figure 1	Number of wells constructed in 1995		Estimated withdrawals from wells (acre-feet)							
				1995					1994	1986-90	1991-95
		Total	Diameter of 12 inches or more	Irrigation	Industry	Public supply	Domestic and stock	Total (rounded)	average (rounded)	average (rounded)	average (rounded)
Curlew Valley	3	1	1	31,000	0	50	50	31,000	41,000	32,000	38,000
Cache Valley	5	59	20	12,000	4,300	4,300	1,800	22,000	31,000	29,000	28,000
East Shore area	9	141	6	[1]25,300	3,400	19,300	5,000	53,000	60,000	65,000	59,000
Salt Lake Valley	10	118	7	1,900	[2]20,600	75,600	22,000	120,000	142,000	138,000	130,000
Tooele Valley	12	70	4	[1]22,700	350	2,800	300	26,000	31,000	26,000	28,000
Utah and Goshen Valleys	16	104	4	30,500	3,000	23,400	20,200	77,000	114,000	108,000	109,000
Juab Valley	21	6	1	11,600	100	[3]700	400	13,000	26,000	22,000	23,000
Sevier Desert	24	18	7	10,400	2,600	3,500	300	17,000	37,000	18,000	30,000
Central Sevier Valley	22	[4]51	3	16,000	1,100	1,100	2,200	20,000	20,000	18,000	19,000
Pahvant Valley	23	4	1	68,600	0	450	100	69,000	93,000	73,000	82,000
Cedar Valley, Iron County	32	15	8	25,900	380	4,200	300	31,000	34,000	24,000	33,000
Parowan Valley	31	4	1	[5]23,100	0	470	250	24,000	30,000	25,000	29,000
Escalante Valley											
Milford area	26	64	5	46,200	[6]400	790	250	48,000	61,000	45,000	51,000
Beryl-Enterprise area	33	23	14	68,600	600	410	750	70,000	86,000	90,000	77,000
Central Virgin River area	34	14	5	1,400	100	13,500	250	15,000	14,000	21,000	14,000
Other areas [7,8]		505	94	43,300	16,200	28,400	6,900	95,000	113,000	91,000	107,000
Total (rounded)		[9]1,197	181	438,000	53,000	179,000	61,000	[10]732,000	933,000	[10]826,000	857,000

[1] Includes some domestic and stock use.

[2] Includes some use for air conditioning, about 16 percent of which is injected back into the aquifer.

[3] Includes some industrial use.

[4] Includes wells constructed in upper Sevier Valley and upper Fremont River Valley.

[5] Includes some use for stock.

[6] Withdrawal for geothermal power generation. About 99 percent was injected back into the aquifer.

[7] Withdrawals are estimated minimum. See page 75 for withdrawal estimates for other areas.

[8] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in reports prior to number 31 of this series.

[9] Includes 707 wells drilled for new appropriations of ground water, 46 replacement wells, and 444 test and monitoring wells. Data from Utah Department of Natural Resources, Division of Water Rights.

Table 3. Total annual withdrawal of water from wells in significant areas of ground-water development in Utah, 1985-94
[From previous reports of this series]

Area	Number in figure 1	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1985-94 average (rounded)
		Thousands of acre-feet										
Curlew Valley	3	27	26	29	34	29	43	37	44	35	41	34
Cache Valley	5	22	23	26	33	30	32	29	36	23	31	29
East Shore area	9	67	66	67	68	61	65	68	59	56	60	64
Salt Lake Valley	10	110	104	122	165	157	143	135	138	116	142	133
Tooele Valley	12	22	21	22	26	27	33	30	30	22	31	26
Utah and Goshen Valleys	16	88	75	104	113	121	129	124	141	89	114	110
Juab Valley	21	11	10	22	22	28	27	25	29	20	26	22
Sevier Desert	24	13	11	15	15	17	34	34	33	31	37	24
Central Sevier Valley [1]	22	17	18	18	17	18	18	18	19	19	20	18
Pahvant Valley	23	62	60	66	71	82	88	74	86	87	93	77
Cedar Valley, Iron County	32	23	19	21	20	28	30	34	34	33	34	28
Parowan Valley	31	25	24	22	20	29	31	32	31	28	30	27
Escalante Valley												
Milford area	26	49	46	44	40	46	48	54	42	50	61	48
Beryl-Enterprise area	33	100	93	97	88	85	86	79	72	78	86	86
Central Virgin River area	34	21	20	20	18	23	22	15	14	13	14	18
Other areas		81	72	79	95	100	111	111	120	94	113	98
Total		738	688	774	845	881	940	899	928	794	933	842

[1] Prior to 1991, included upper Sevier and upper Fremont River Valleys.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

By J.D. Sory

Total estimated withdrawal of water from wells in Curlew Valley in 1995 was about 31,000 acre-feet, which is 10,000 acre-feet less than was reported for 1994 and 3,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95, 38,000 acre-feet, is 6,000 acre-feet more than for the preceding 5-year period, 1986-90. All of the increased withdrawals were for irrigation.

Water levels in Curlew Valley generally declined from March 1991 to March 1996, with the largest decline, 3.9 feet, measured in a well about 3 miles northeast of Curlew Junction (fig. 2). The declines are the result of increased withdrawals for 1991-95 as compared with the preceding 5-year period, 1986-90. Precipitation at Grouse Creek during 1995 was 15.59 inches, which is 7.78 inches more than in 1994 and 4.52 inches more than the average annual precipitation for 1959-96. The average annual precipitation during 1991-95 was 10.75 inches, which is 1.15 inches more than for the preceding 5-year period, 1986-90.

The relation of water levels in two selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3. The hydrographs for wells (B-12-11)16cdc-1, near the irrigated area of Kelton, and (B-14-9)7bbb-1, in the irrigated areas near Snowville, are representative of the ground-water levels in those areas, and show the effects of withdrawals for irrigation and recharge from precipitation.

The concentration of dissolved solids in water from well (B-12-11)4bcc-1, near Kelton, increased during 1972-95 from about 1,200 milligrams per liter to about 2,500 milligrams per liter. Two possible causes of this increase are movement of saline water toward the well because of water-level declines in the area, and recharge from unconsumed irrigation water in which dissolved solids have been concentrated by evaporation.

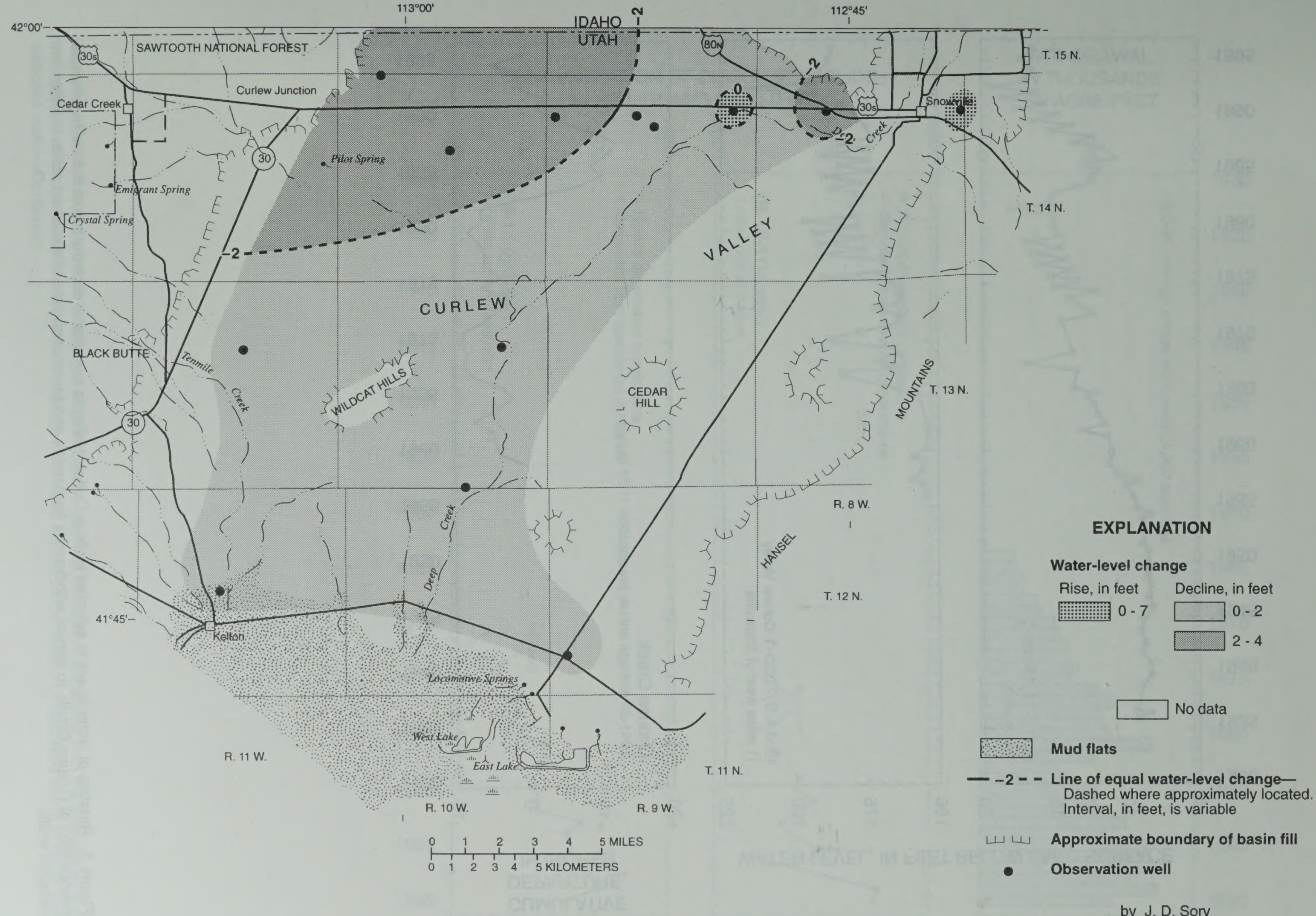


Figure 2. Map of Curlew Valley showing change of water levels from March 1991 to March 1996.

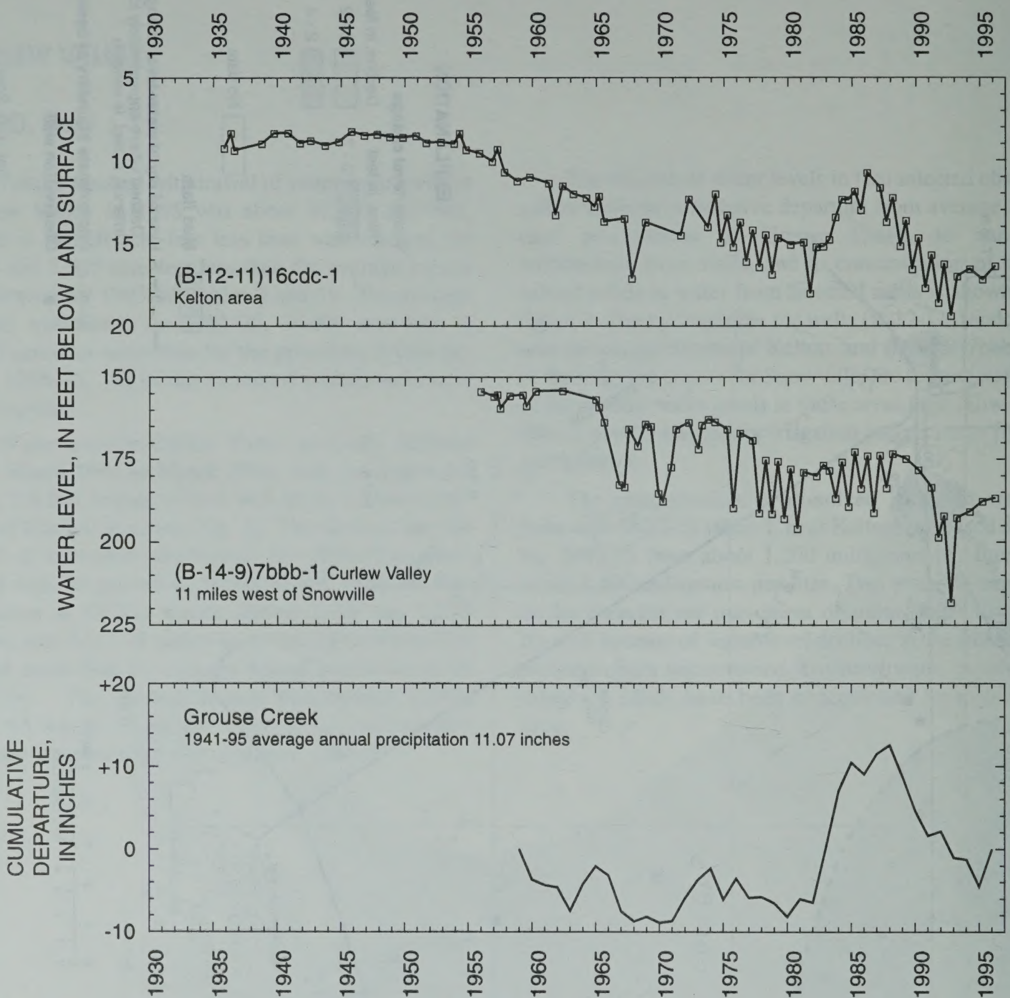


Figure 3. Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Grouse Creek, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

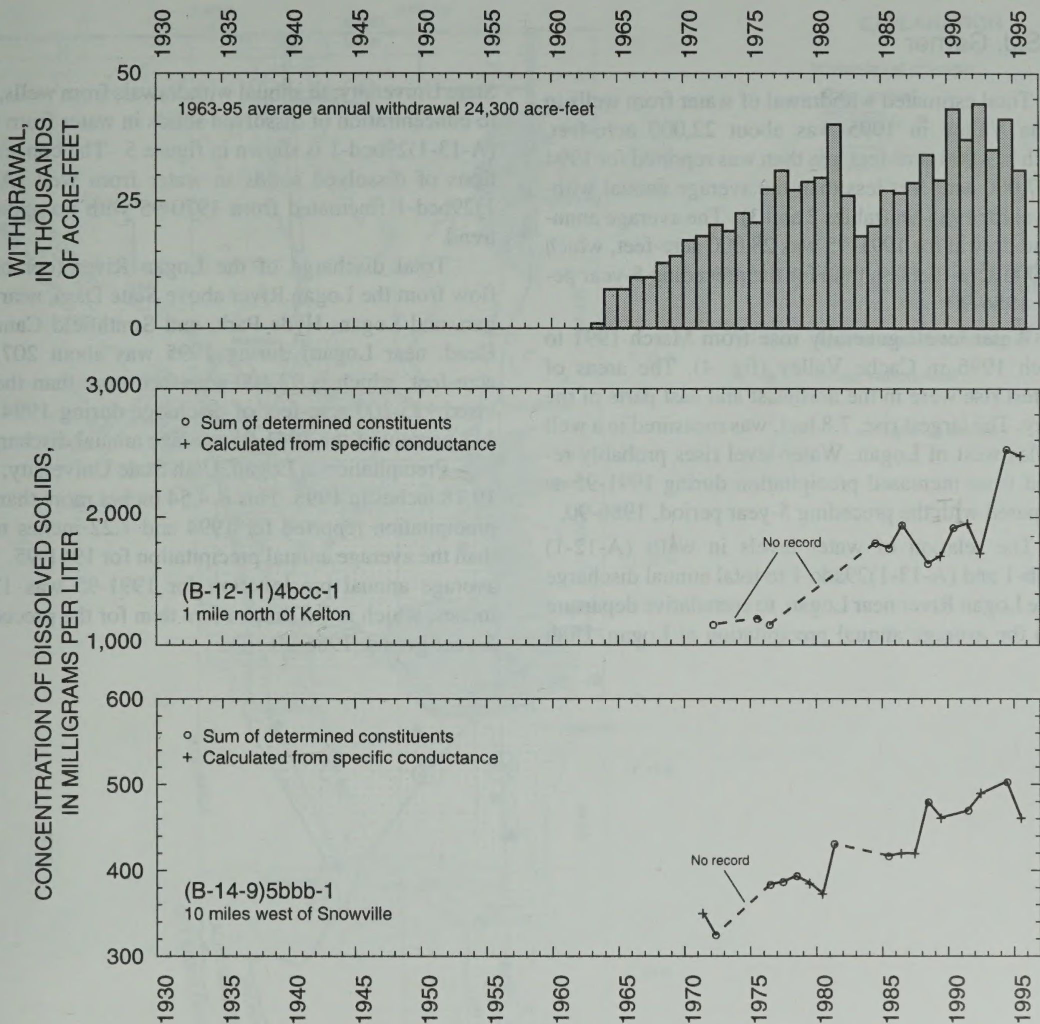


Figure 3. Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Grouse Creek, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CACHE VALLEY

By S.J. Gerner

Total estimated withdrawal of water from wells in Cache Valley in 1995 was about 22,000 acre-feet, which is 9,000 acre-feet less than was reported for 1994 and 7,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95 was 28,000 acre-feet, which is 1,000 acre-feet less than for the preceding 5-year period, 1986-90.

Water levels generally rose from March 1991 to March 1996 in Cache Valley (fig. 4). The areas of greatest rise were in the northeast and east parts of the valley. The largest rise, 7.8 feet, was measured in a well 3 miles west of Logan. Water-level rises probably resulted from increased precipitation during 1991-95 as compared with the preceding 5-year period, 1986-90.

The relation of water levels in wells (A-12-1) 29cab-1 and (A-13-1)29adc-1 to total annual discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 5. The concentrations of dissolved solids in water from well (A-13-1)29bcd-1 fluctuated from 1970-95 with no apparent trend.

Total discharge of the Logan River (combined flow from the Logan River above State Dam, near Logan, and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 1995 was about 207,600 acre-feet, which is 92,400 acre-feet more than the revised 115,200 acre-feet of discharge during 1994 and 115 percent of the 1941-95 average annual discharge.

Precipitation at Logan, Utah State University, was 19.78 inches in 1995. This is 4.54 inches more than the precipitation reported for 1994 and 1.22 inches more than the average annual precipitation for 1941-95. The average annual precipitation for 1991-95 was 17.84 inches, which is 0.52 inch more than for the preceding 5-year period, 1986-90.

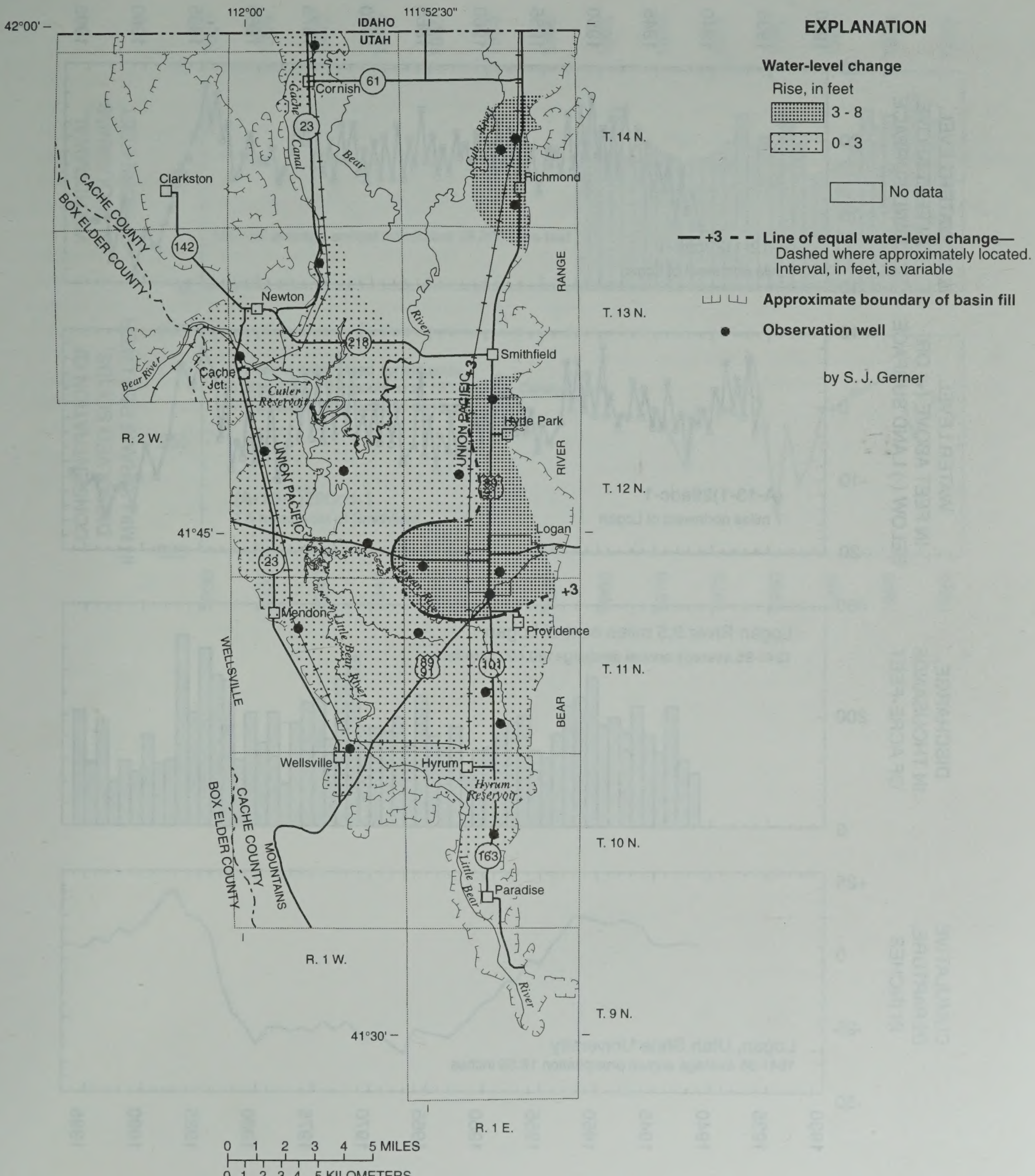


Figure 4. Map of Cache Valley showing change of water levels from March 1991 to March 1996.

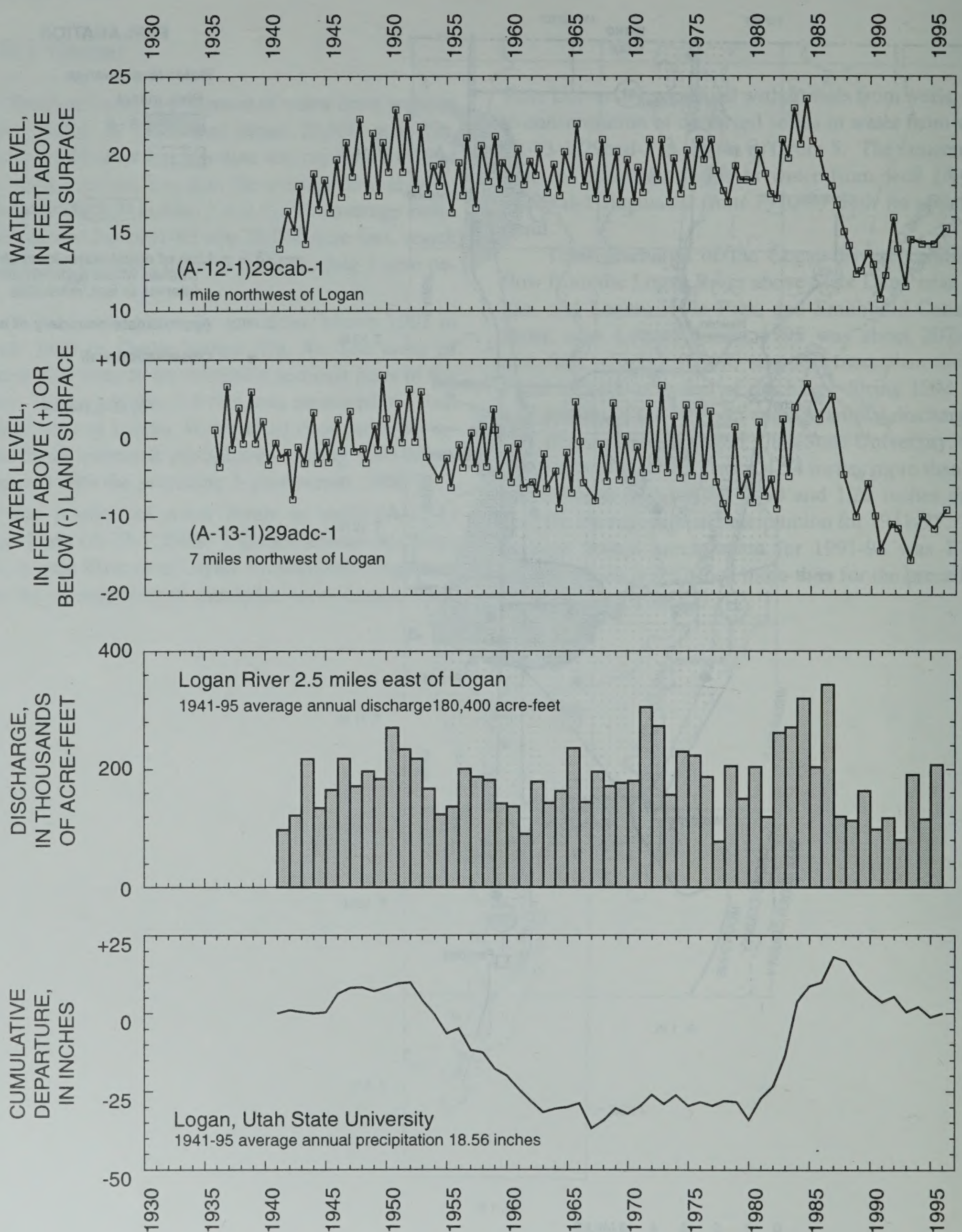


Figure 5. Relation of water levels in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.

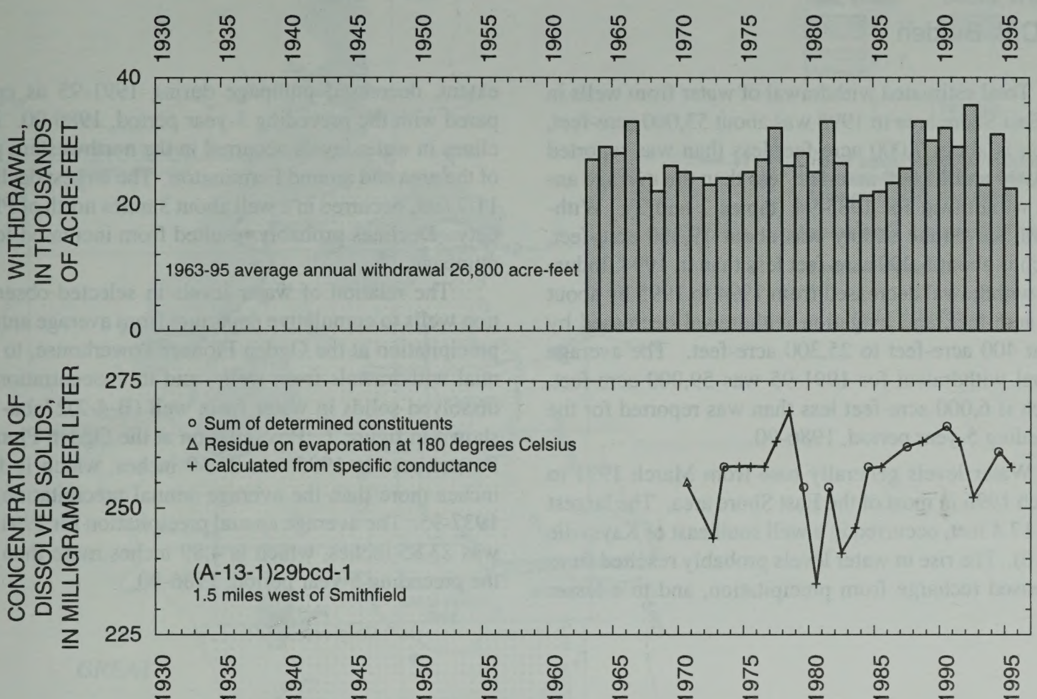


Figure 5. Relation of water levels in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1—Continued.

EAST SHORE AREA

By C.B. Burden

Total estimated withdrawal of water from wells in the East Shore area in 1995 was about 53,000 acre-feet, which is about 7,000 acre-feet less than was reported for 1994 and 11,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). Withdrawal for public supply was about 19,300 acre-feet, which is about 5,900 acre-feet less than in 1994. Industrial withdrawal decreased from 1994 to 1995 by about 600 acre-feet, and irrigation withdrawal decreased by about 400 acre-feet to 25,300 acre-feet. The average annual withdrawal for 1991-95 was 59,000 acre-feet, which is 6,000 acre-feet less than was reported for the preceding 5-year period, 1986-90.

Water levels generally rose from March 1991 to March 1996 in most of the East Shore area. The largest rise, 17.4 feet, occurred in a well southeast of Kaysville (fig. 6). The rise in water levels probably resulted from increased recharge from precipitation, and to a lesser extent, decreased pumpage during 1991-95 as compared with the preceding 5-year period, 1986-90. Declines in water levels occurred in the northwestern part of the area and around Farmington. The largest decline, 11.7 feet, occurred in a well about 3 miles north of Plain City. Declines probably resulted from increased local pumpage.

The relation of water levels in selected observation wells to cumulative departure from average annual precipitation at the Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7. Precipitation at the Ogden Pioneer Powerhouse in 1995 was 23.50 inches, which is 1.85 inches more than the average annual precipitation for 1937-95. The average annual precipitation for 1991-95 was 23.85 inches, which is 4.89 inches more than for the preceding 5-year period, 1986-90.

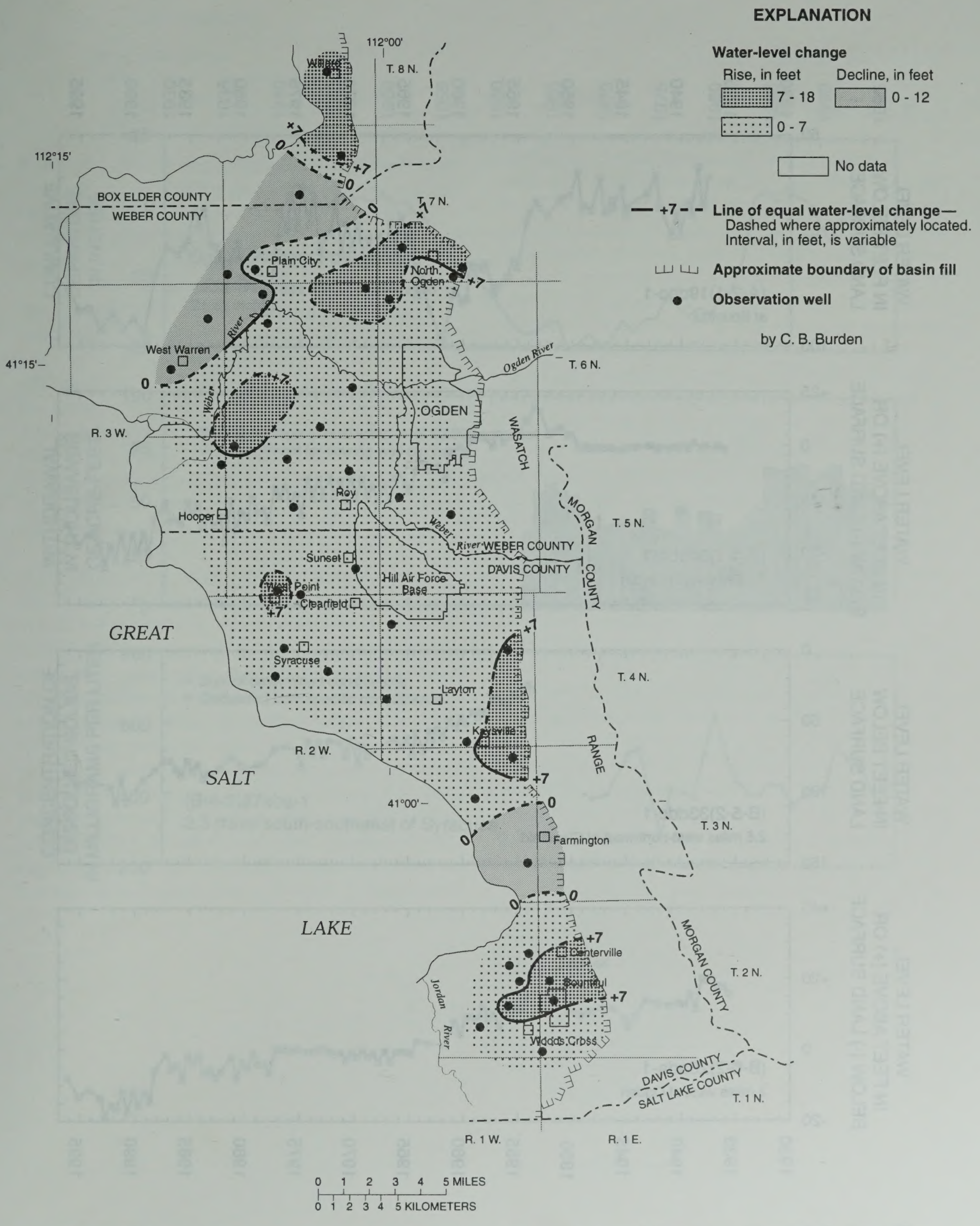


Figure 6. Map of the East Shore area showing change of water levels from March 1991 to March 1996.

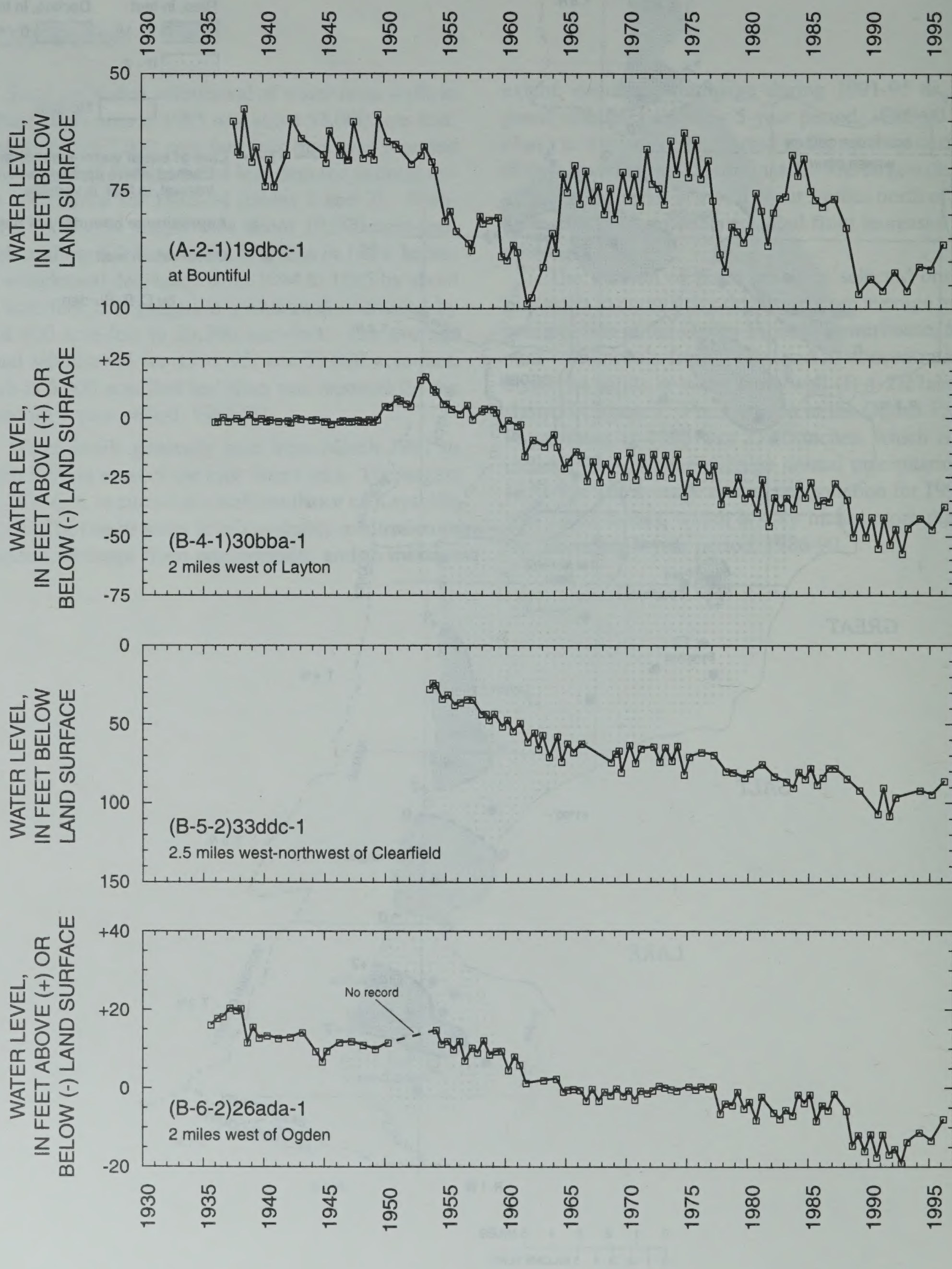


Figure 7. Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

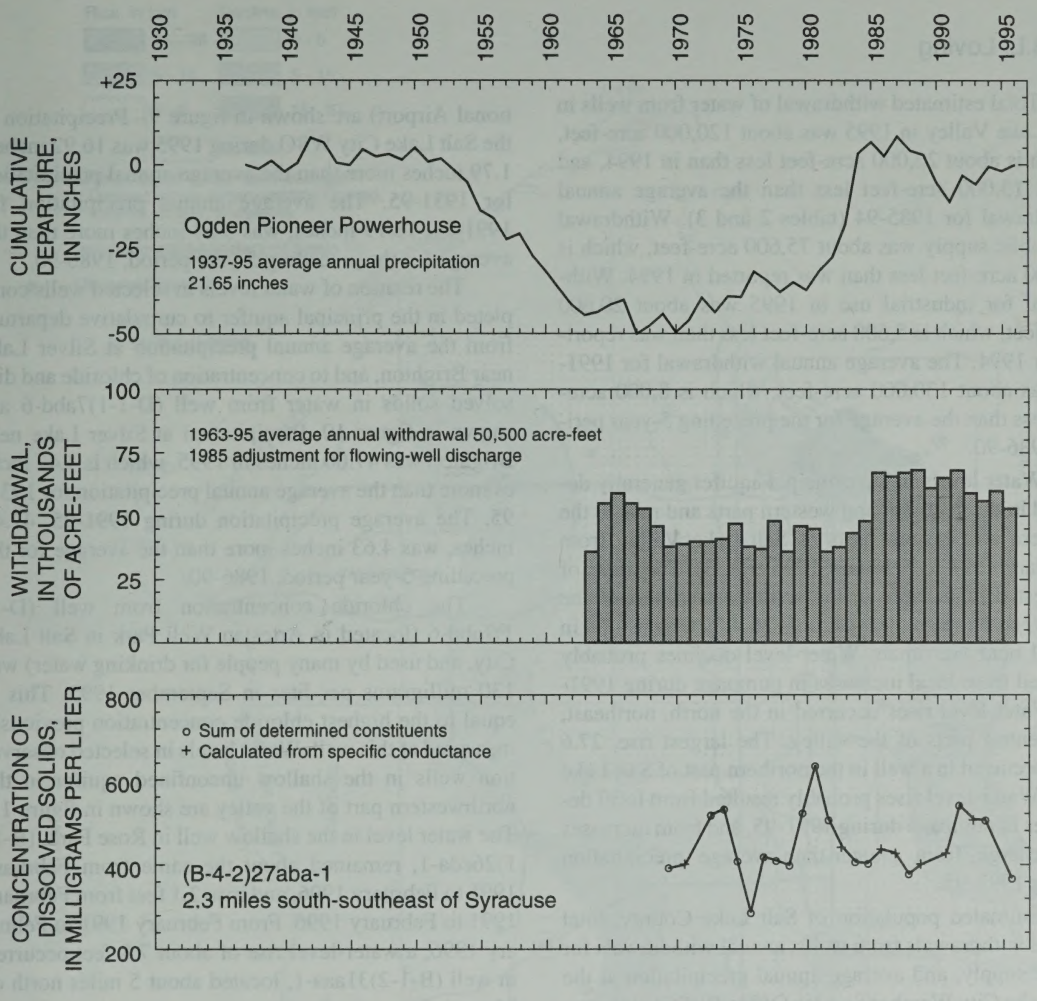


Figure 7. Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

SALT LAKE VALLEY

By B.L. Loving

Total estimated withdrawal of water from wells in Salt Lake Valley in 1995 was about 120,000 acre-feet, which is about 22,000 acre-feet less than in 1994, and about 13,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). Withdrawal for public supply was about 75,600 acre-feet, which is 10,200 acre-feet less than was reported in 1994. Withdrawal for industrial use in 1995 was about 20,600 acre-feet, which is 5,600 acre-feet less than was reported for 1994. The average annual withdrawal for 1991-95 was about 130,000 acre-feet, which is 8,000 acre-feet less than the average for the preceding 5-year period, 1986-90.

Water levels in the principal aquifer generally declined in the southern and western parts and rose in the northern and eastern parts of Salt Lake Valley from February 1991 to February 1996 (fig. 8). The areas of greatest decline were in the southwestern part of the valley, with the greatest decline, 26.4 feet, measured in a well near Herriman. Water-level declines probably resulted from local increases in pumpage during 1991-95. Water-level rises occurred in the north, northeast, and central parts of the valley. The largest rise, 27.6 feet, occurred in a well in the northern part of Salt Lake City. Water-level rises probably resulted from local decreases in pumpage during 1991-95, and from increases in recharge from greater-than-average precipitation during 1993-95.

Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawals for public supply, and average annual precipitation at the Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 9. Precipitation at the Salt Lake City WSO during 1995 was 16.92 inches, 1.79 inches more than the average annual precipitation for 1931-95. The average annual precipitation for 1991-95, 16.19 inches, was 3.64 inches more than the average for the preceding 5-year period, 1986-90.

The relation of water levels in selected wells completed in the principal aquifer to cumulative departure from the average annual precipitation at Silver Lake near Brighton, and to concentration of chloride and dissolved solids in water from well (D-1-1)7abd-6 are shown in figure 10. Precipitation at Silver Lake near Brighton was 47.00 inches in 1995, which is 4.42 inches more than the average annual precipitation for 1931-95. The average precipitation during 1991-95, 42.43 inches, was 4.63 inches more than the average for the preceding 5-year period, 1986-90.

The chloride concentration from well (D-1-1)7abd-6 (located in Artesian Well Park in Salt Lake City, and used by many people for drinking water) was 130 milligrams per liter in September 1995. This is equal to the highest chloride concentration previously measured at this well. Water levels in selected observation wells in the shallow unconfined aquifer in the northwestern part of the valley are shown in figure 11. The water level in the shallow well in Rose Park, (B-1-1)26cda-1, remained about the same from February 1995 to February 1996, and rose 2.1 feet from February 1991 to February 1996. From February 1991 to February 1996, a water-level rise of about 7.8 feet occurred in well (B-1-2)31aaa-1, located about 5 miles north of Magna.

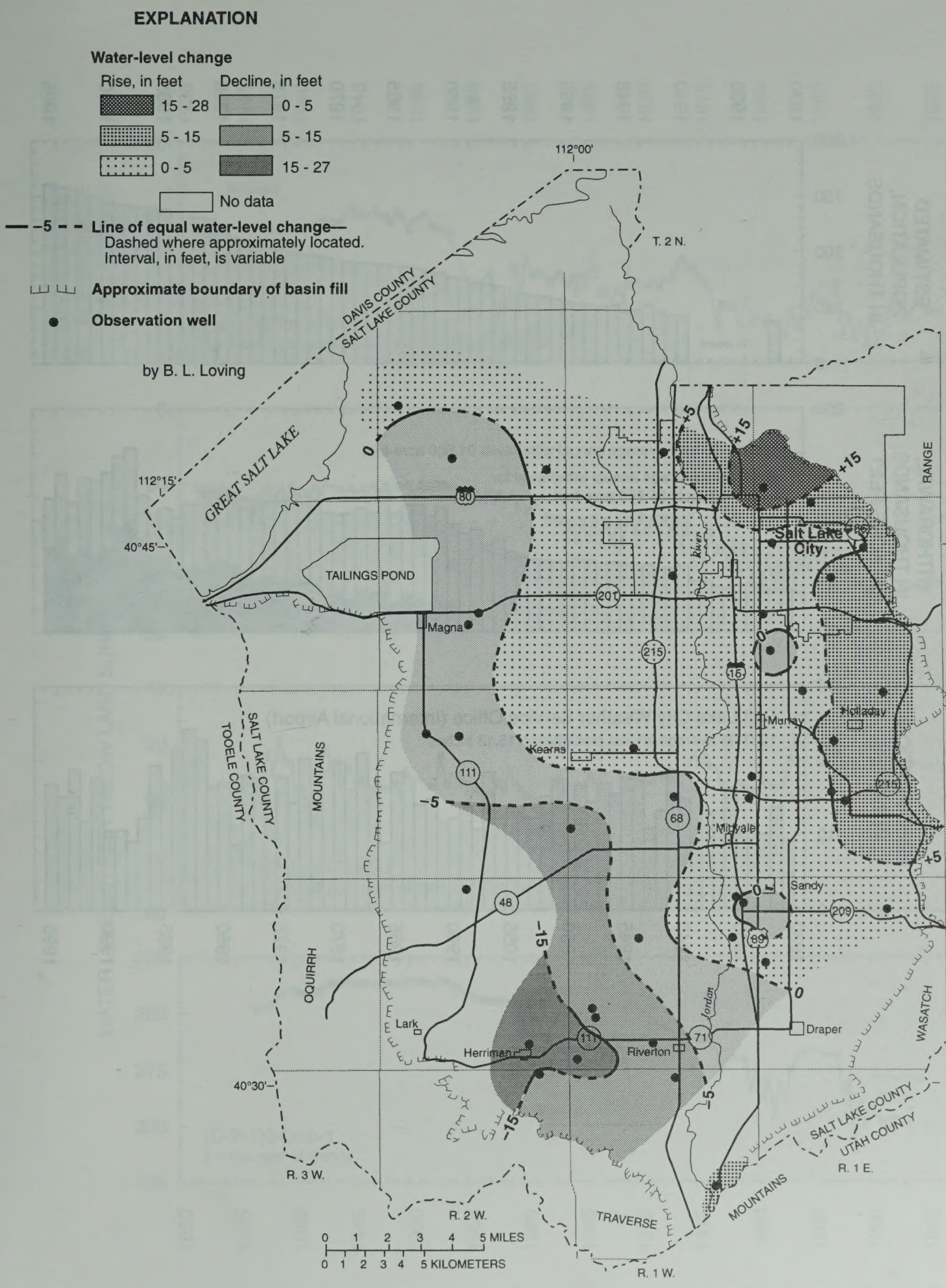


Figure 8. Map of Salt Lake Valley showing change of water levels in the principal aquifer from February 1991 to February 1996.

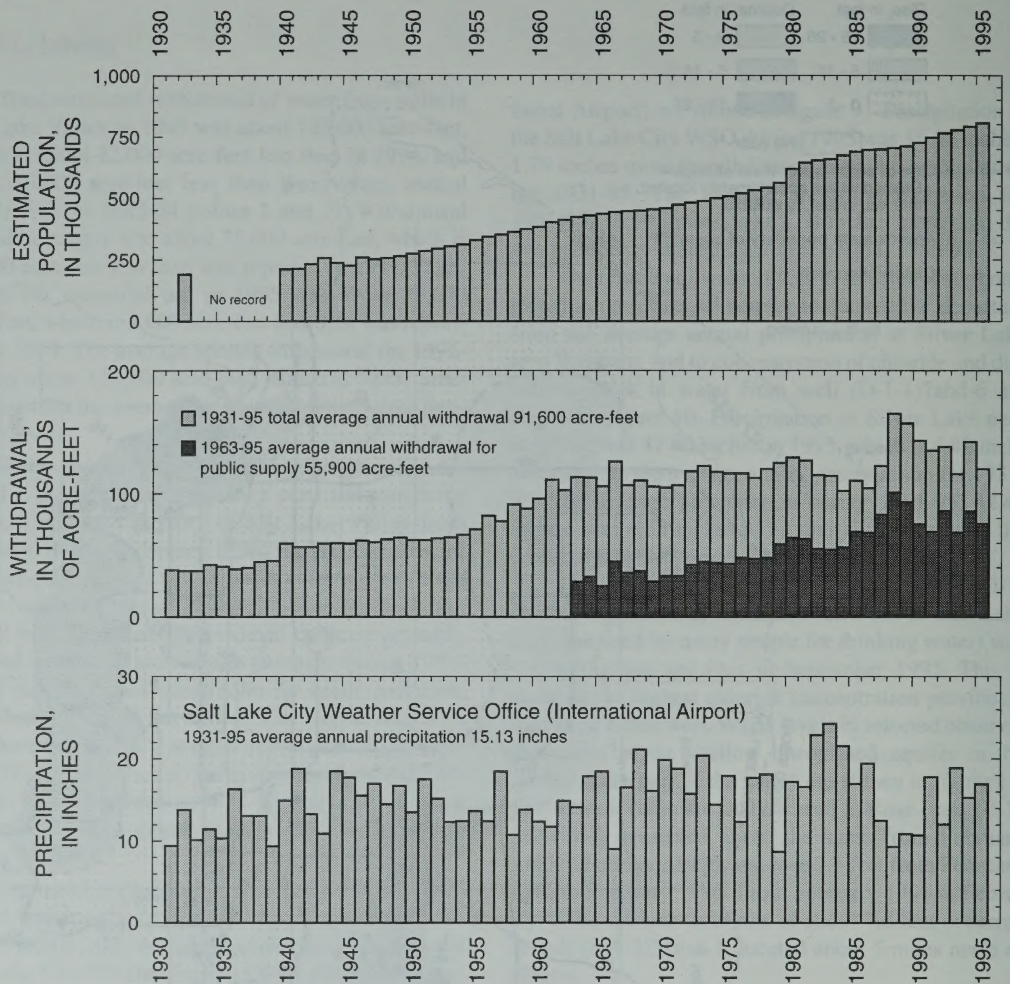


Figure 9. Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawals for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

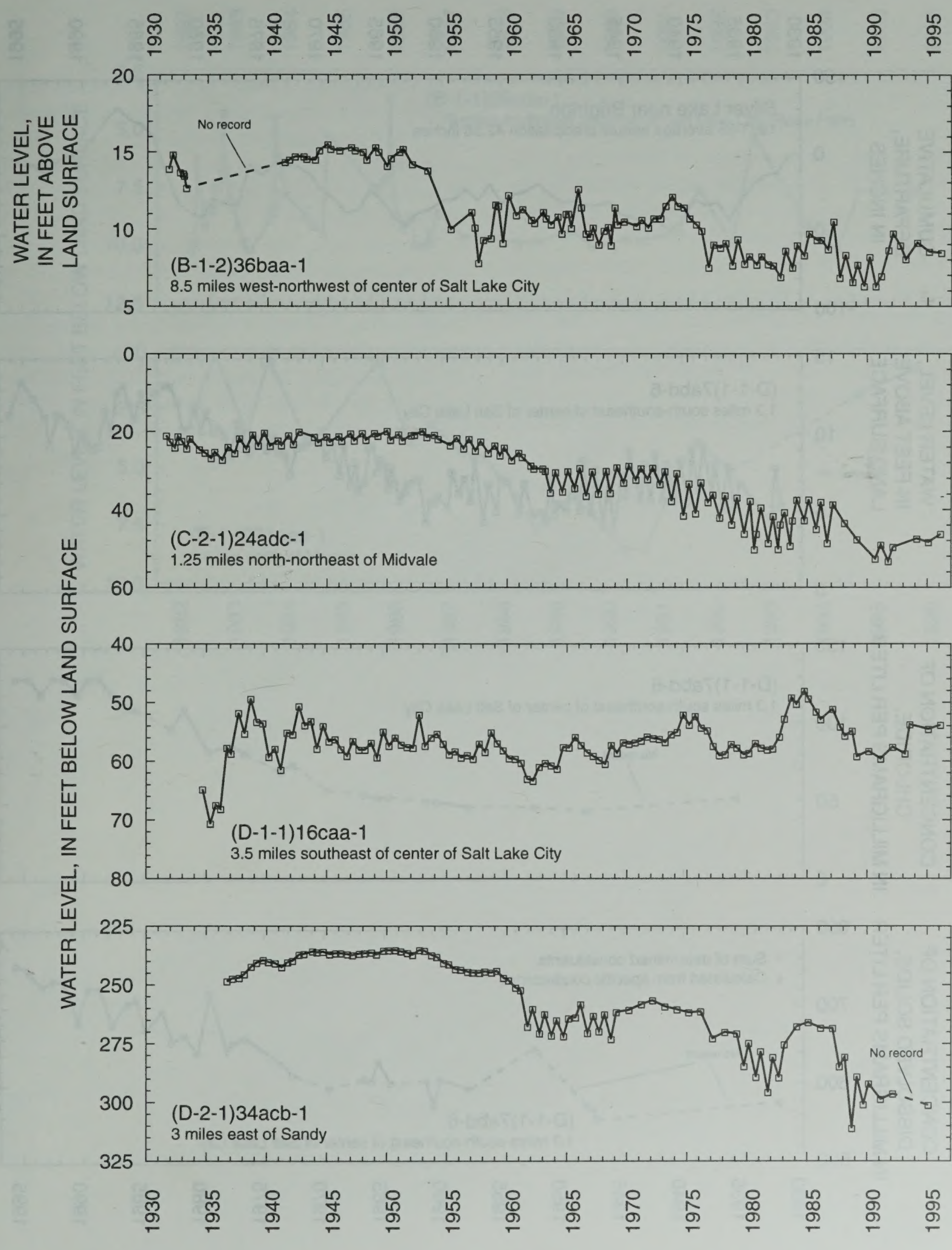


Figure 10. Relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake near Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

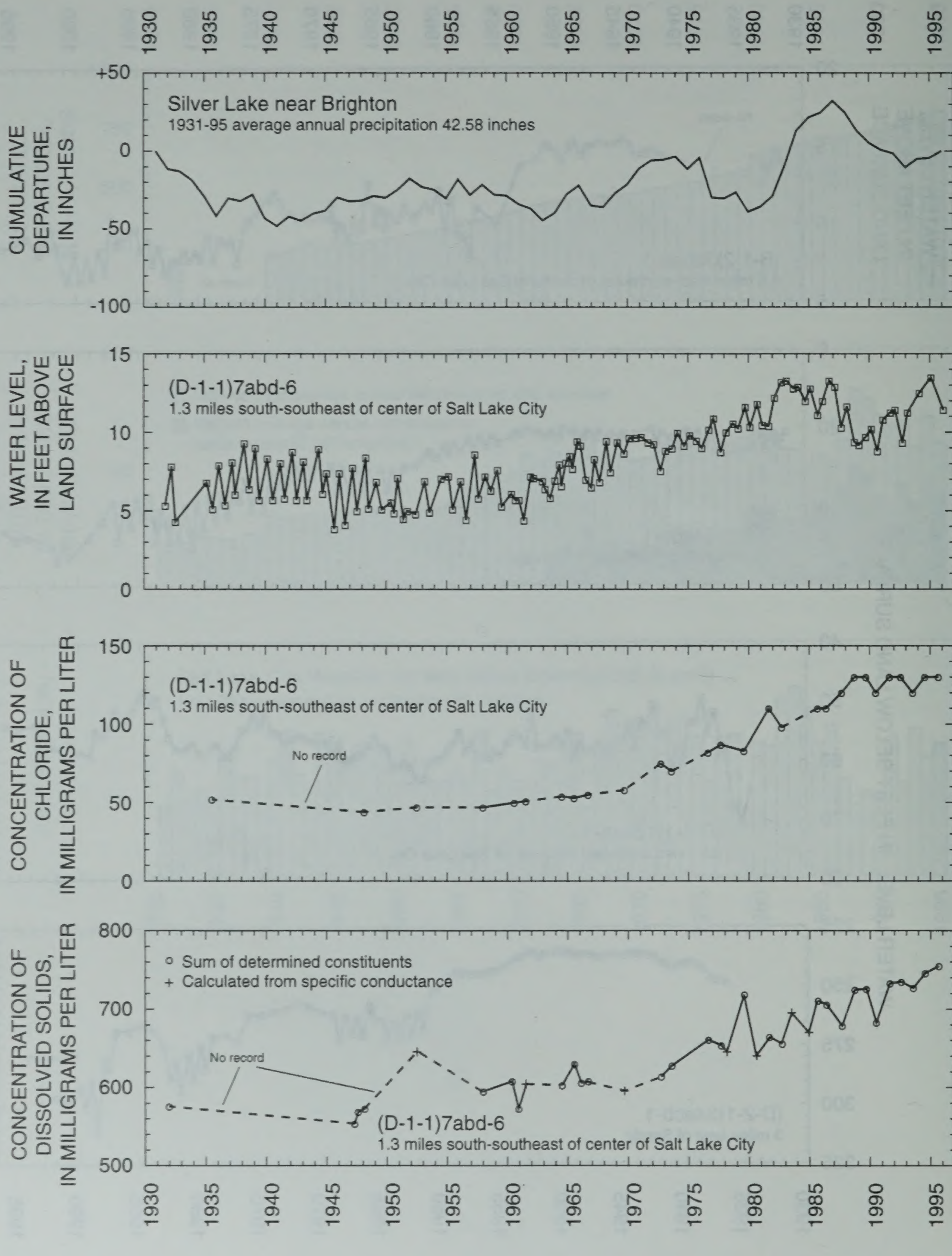


Figure 10. Relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake near Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

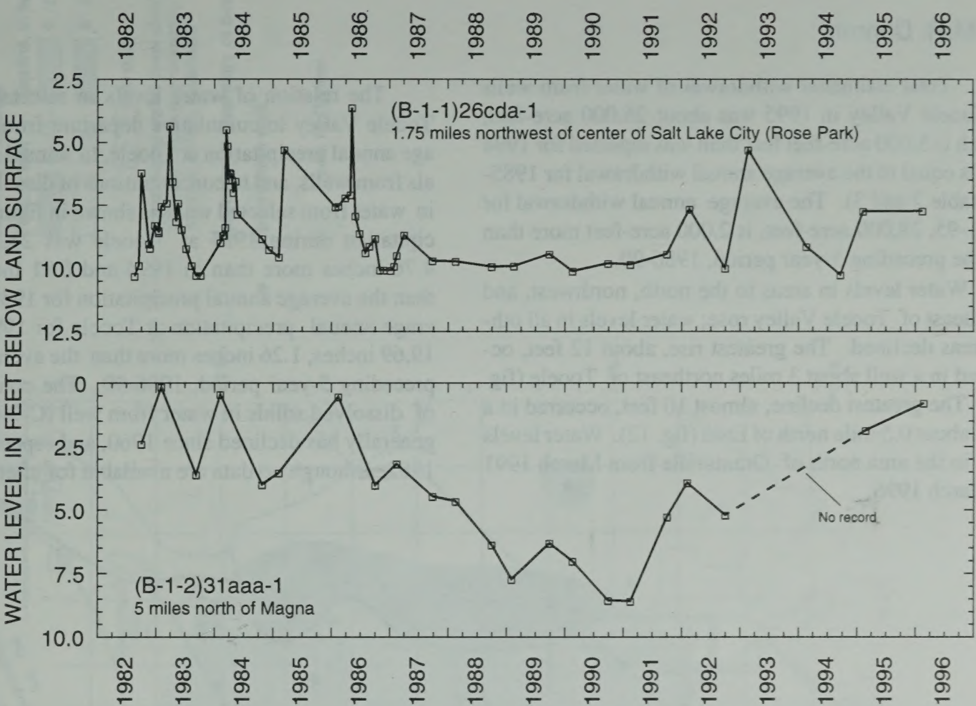


Figure 11. Water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley.

TOOELE VALLEY

By M.R. Danner

Total estimated withdrawal of water from wells in Tooele Valley in 1995 was about 26,000 acre-feet, which is 5,000 acre-feet less than was reported for 1994 and is equal to the average annual withdrawal for 1985-94 (table 2 and 3). The average annual withdrawal for 1991-95, 28,000 acre-feet, is 2,000 acre-feet more than for the preceding 5-year period, 1986-90.

Water levels in areas to the north, northwest, and southeast of Tooele Valley rose; water levels in all other areas declined. The greatest rise, about 12 feet, occurred in a well about 3 miles northeast of Tooele (fig. 12). The greatest decline, almost 10 feet, occurred in a well about 0.5 mile north of Erda (fig. 12). Water levels rose in the area north of Grantsville from March 1991 to March 1996.

The relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentrations of dissolved solids in water from selected wells is shown in figure 13. Precipitation during 1995 at Tooele was 24.34 inches, 4.76 inches more than in 1994 and 6.81 inches more than the average annual precipitation for 1936-95. Average annual precipitation at Tooele for 1991-95 was 19.69 inches, 1.26 inches more than the average for the preceding 5-year period, 1986-90. The concentration of dissolved solids in water from well (C-2-6)23cbb-1 generally has declined since 1960, and especially since 1982, although no data are available for after 1992.

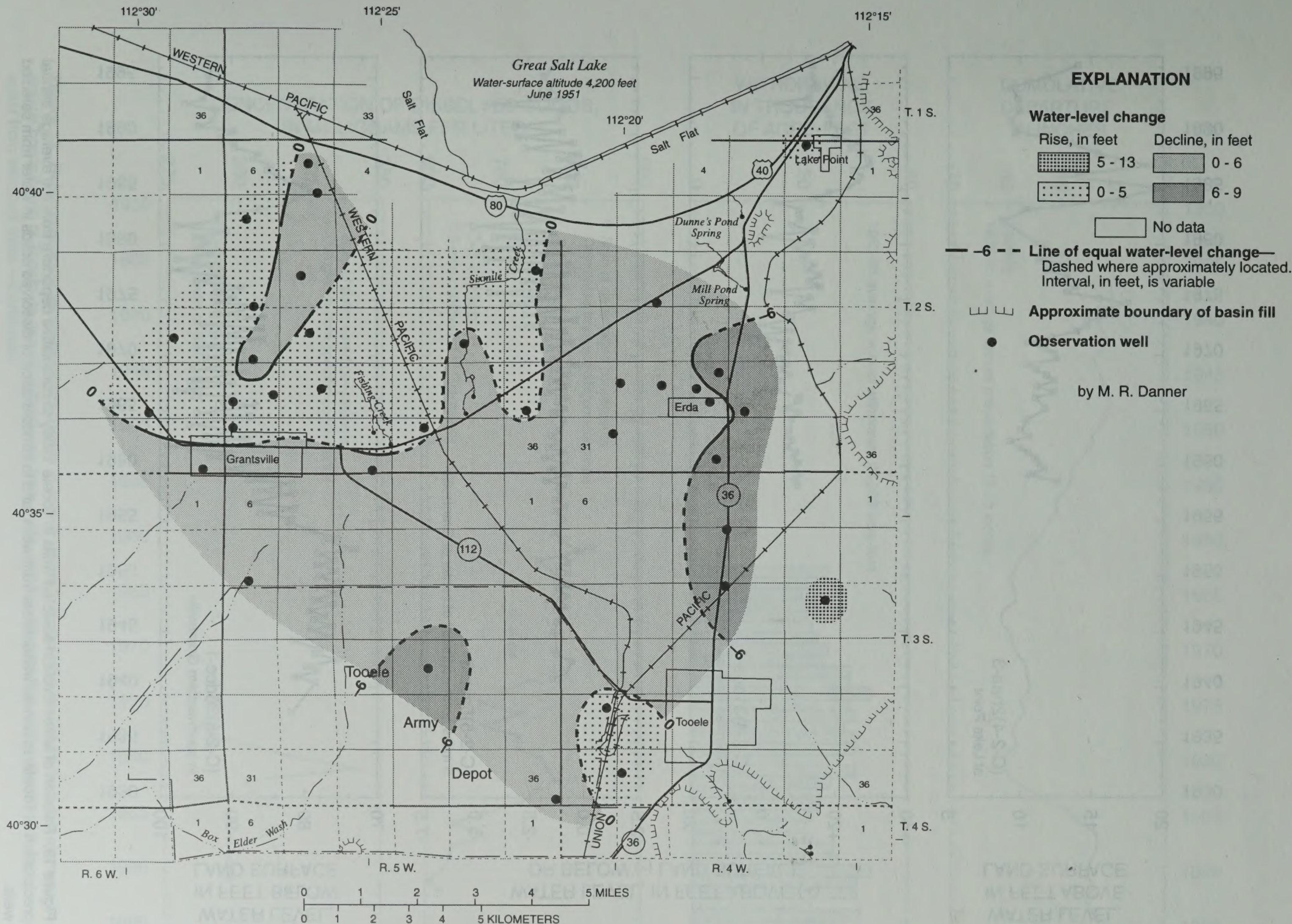


Figure 12. Map of Tooele Valley showing change of water levels from March 1991 to March 1996.

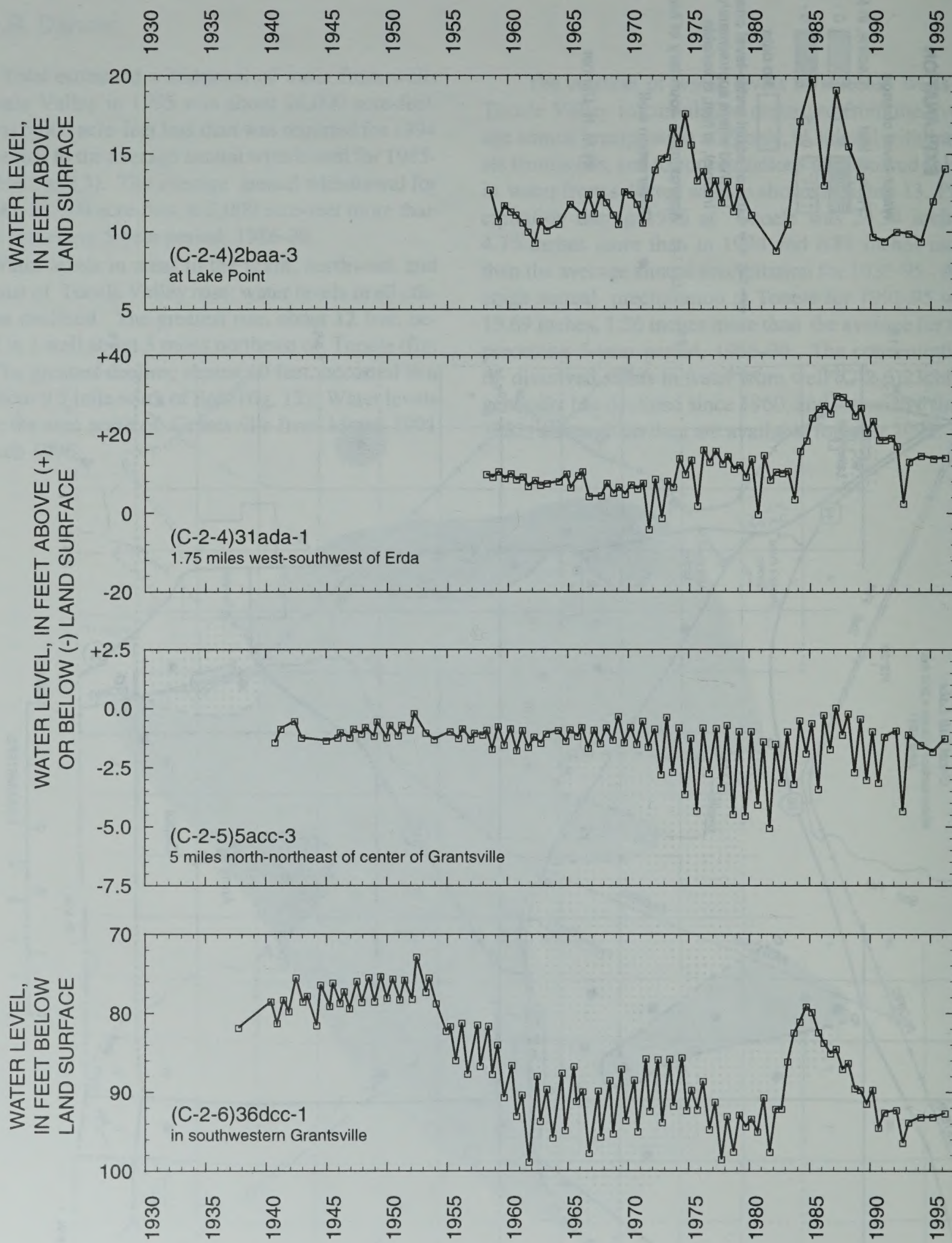


Figure 13. Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

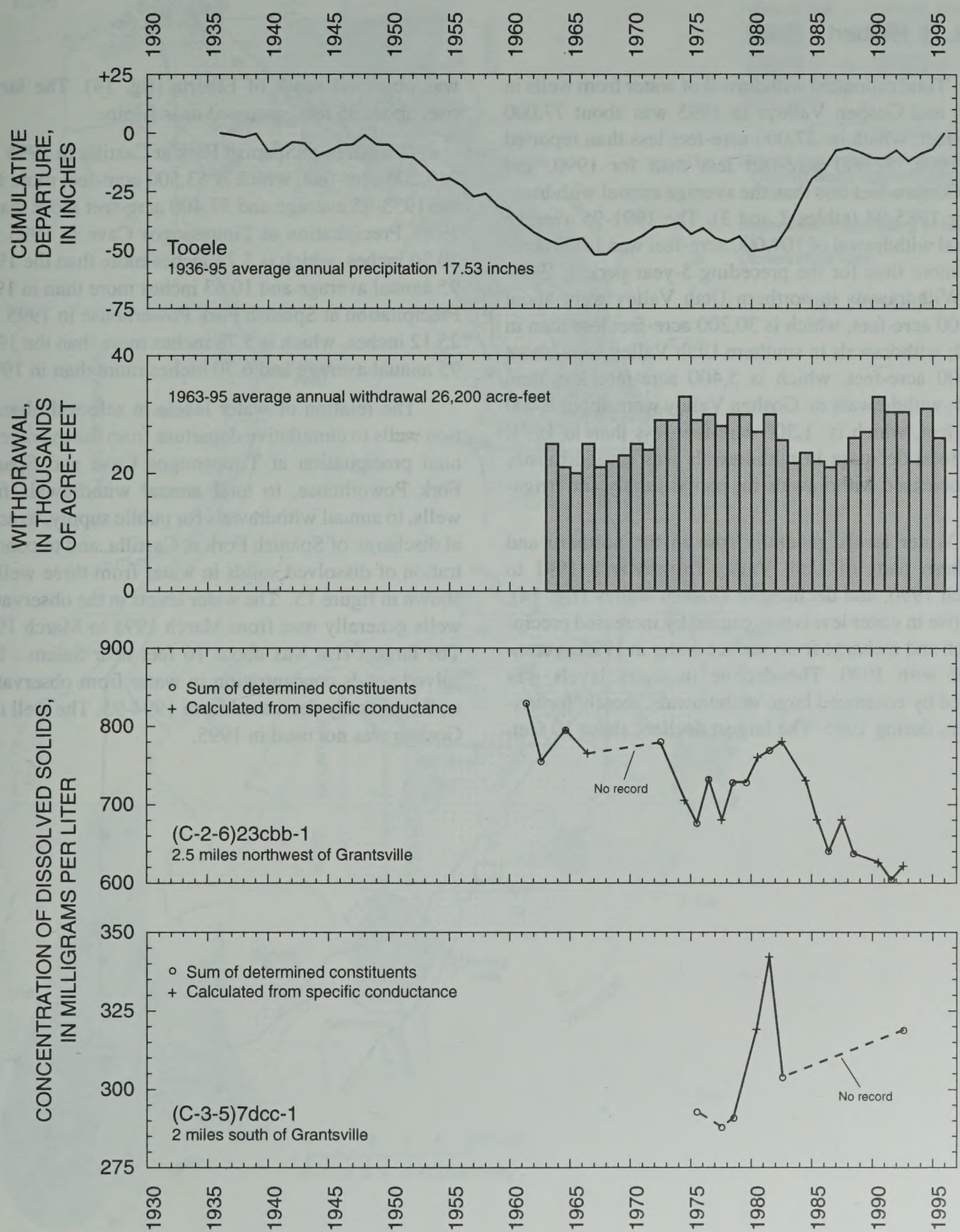


Figure 13. Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

UTAH AND GOSHEN VALLEYS

By L.R. Herbert

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 1995 was about 77,000 acre-feet, which is 37,000 acre-feet less than reported for 1994, 52,000 acre-feet less than for 1990, and 33,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). The 1991-95 average annual withdrawal of 109,000 acre-feet was 1,000 acre-feet more than for the preceding 5-year period, 1986-90. Withdrawals in northern Utah Valley were about 50,400 acre-feet, which is 30,200 acre-feet less than in 1994; withdrawals in southern Utah Valley were about 18,300 acre-feet, which is 5,400 acre-feet less than 1994; withdrawals in Goshen Valley were about 8,400 acre-feet, which is 1,300 acre-feet less than in 1994. The total decrease in withdrawals was caused mostly by decreased withdrawals for public supply and irrigation.

Water levels generally rose in the northern and southern parts of Utah Valley from March 1991 to March 1996, and declined in Goshen Valley (fig. 14). The rise in water levels was caused by increased precipitation and recharge from surface water in 1995 as compared with 1990. The decline in water levels was caused by continued large withdrawals, mostly for irrigation, during 1995. The largest decline, about 10 feet, was observed south of Elberta (fig. 14). The largest rise, about 35 feet, occurred near Alpine.

Discharge at Spanish Fork at Castilla in 1995 was 219,200 acre-feet, which is 53,500 acre-feet more than the 1933-95 average and 57,400 acre-feet more than in 1990. Precipitation at Timpanogos Cave in 1995 was 30.70 inches, which is 5.73 inches more than the 1947-95 annual average and 10.63 inches more than in 1990. Precipitation at Spanish Fork Powerhouse in 1995 was 25.12 inches, which is 5.78 inches more than the 1937-95 annual average and 6.70 inches more than in 1990.

The relation of water levels in selected observation wells to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells is shown in figure 15. The water levels in the observation wells generally rose from March 1995 to March 1996. The largest rise was about 16 feet near Salem. Dissolved-solids concentration in water from observation wells generally decreased from 1994-95. The well near Goshen was not used in 1995.

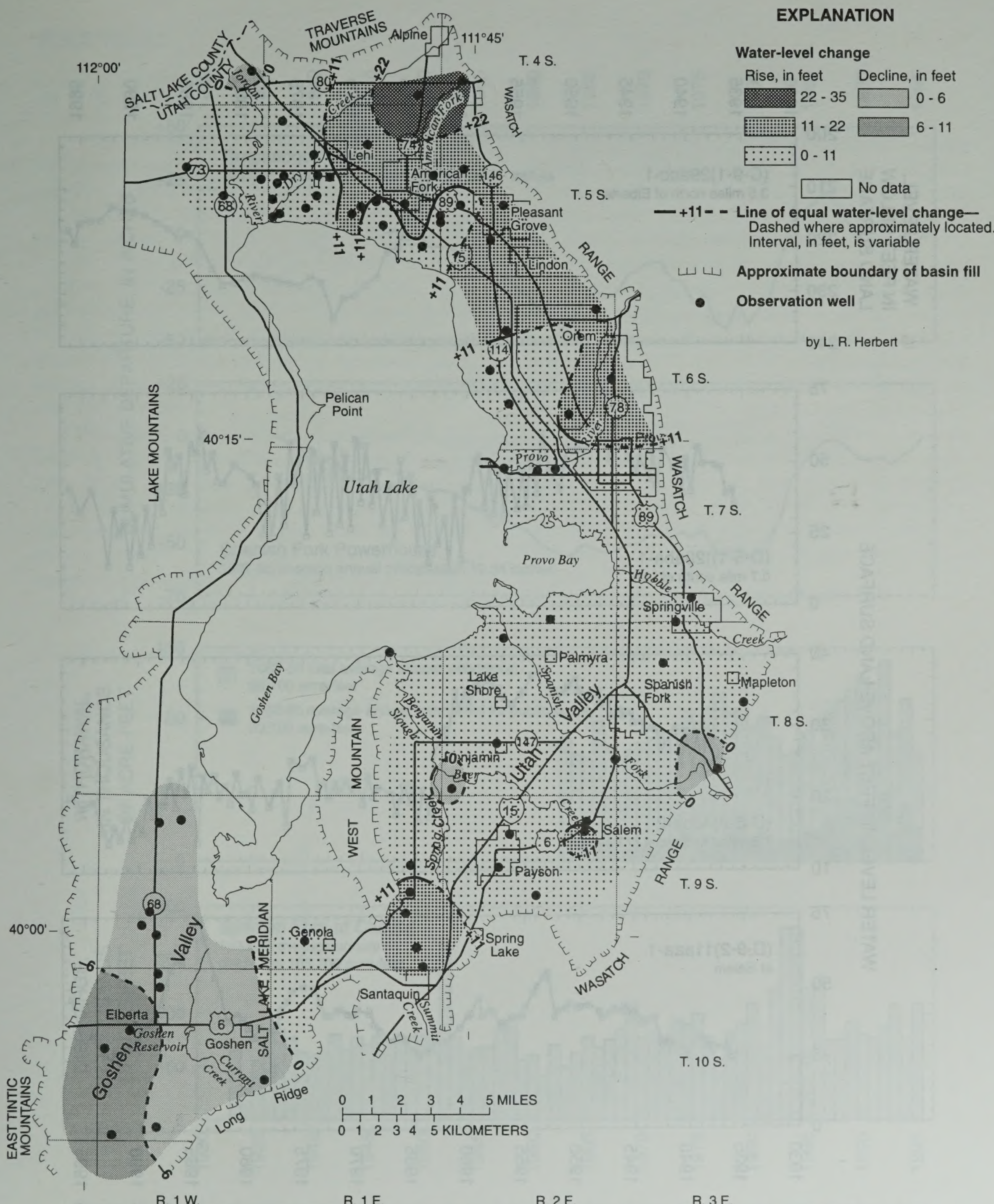


Figure 14. Map of Utah and Goshen Valleys showing change of water levels from March 1991 to March 1996.

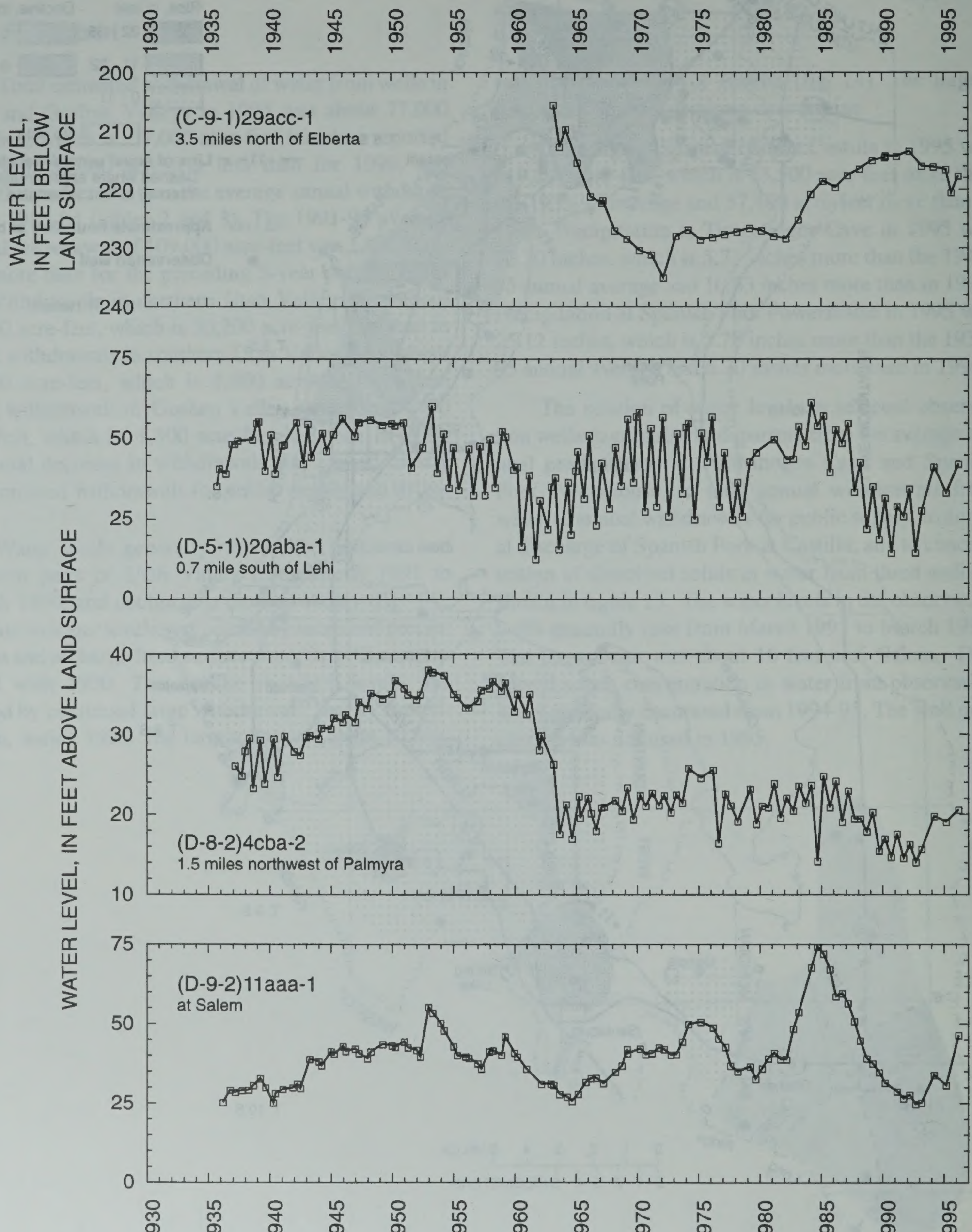


Figure 15. Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells.

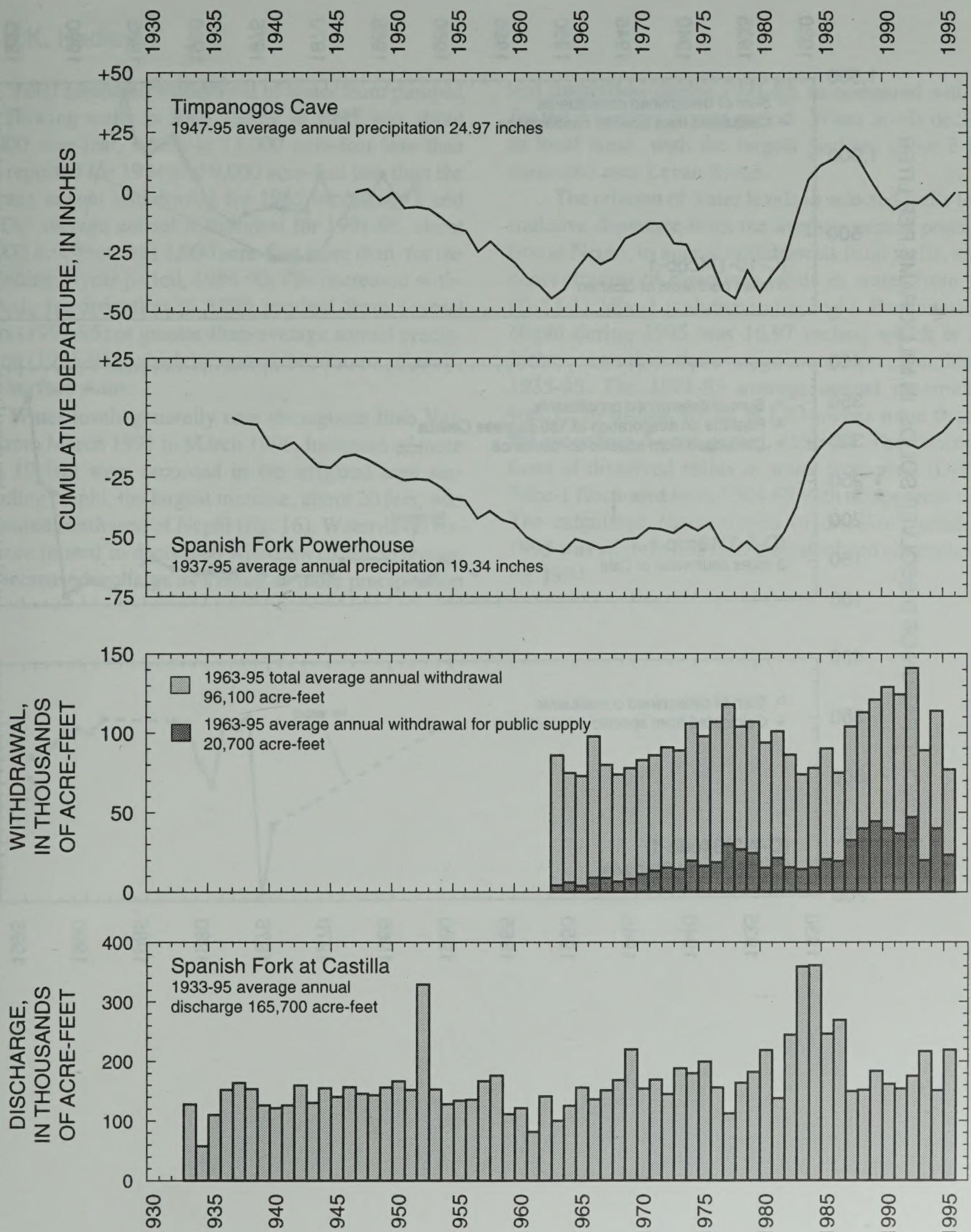


Figure 15. Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells—Continued.

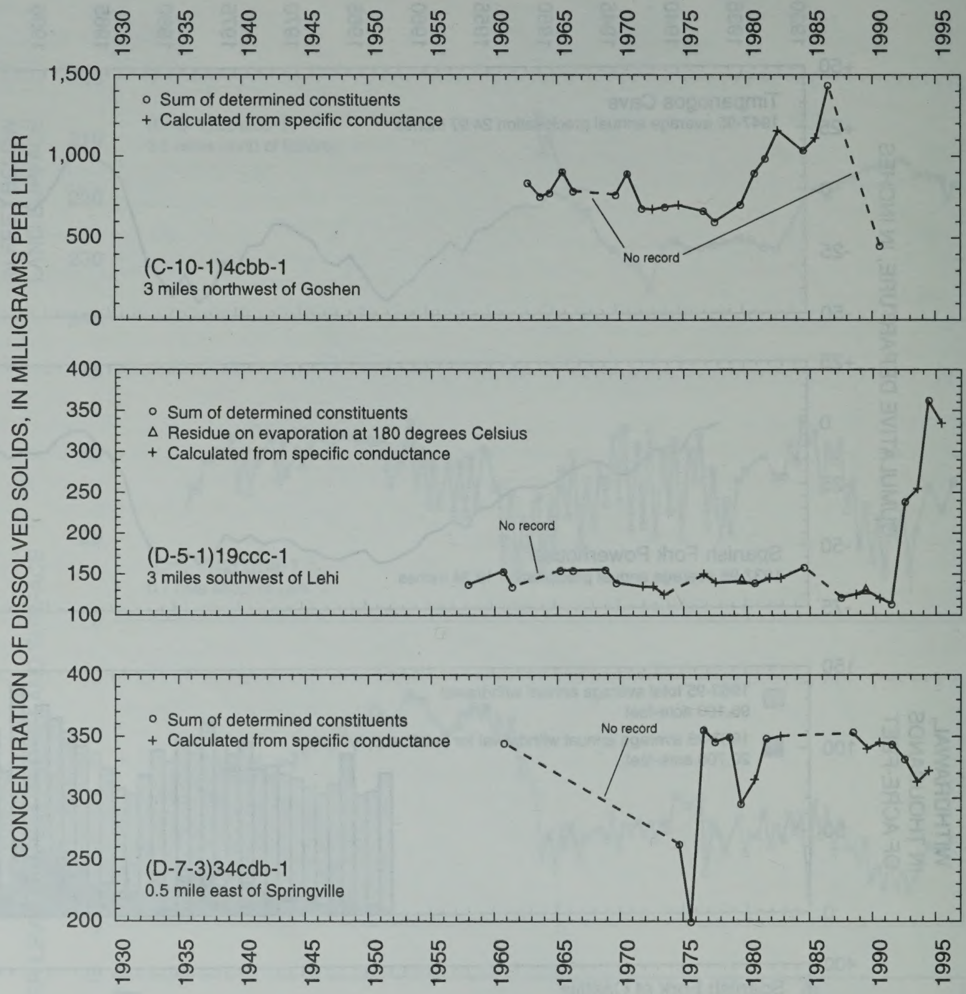


Figure 15. Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells—Continued.

JUAB VALLEY

By H.K. Hadley

Total estimated withdrawal of water from pumped and flowing wells in Juab Valley in 1995 was about 13,000 acre-feet, which is 13,000 acre-feet less than was reported for 1994 and 9,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95, about 23,000 acre-feet, was 1,000 acre-feet more than for the preceding 5-year period, 1986-90. The decreased withdrawals for irrigation in 1995 resulted from several years (1992-95) of greater-than-average annual precipitation (1935-95), which increased the amount of available surface water.

Water levels generally rose throughout Juab Valley from March 1991 to March 1996. Increases of more than 10 feet were recorded in the irrigated area surrounding Nephi; the largest increase, about 20 feet, was measured southwest of Nephi (fig. 16). Water-level rises were related to decreased withdrawals for irrigation and increased recharge as a result of more precipitation and streamflow during 1991-95, as compared with that for the preceding 5-year period. Water levels declined in local areas, with the largest decline, about 8 feet, measured near Levan Ridge.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1) 7dbc-1 is shown in figure 17. Precipitation at Nephi during 1995 was 16.97 inches, which is 2.58 inches more than the average annual precipitation for 1935-95. The 1991-95 average annual precipitation was 15.76 inches, which is 1.83 inches more than for the preceding 5-year period, 1986-90. The concentrations of dissolved solids in water from well (D-13-1) 7dbc-1 fluctuated from 1964-95 with no apparent trend. The calculated concentration of dissolved solids for 1995 was slightly less than the calculated concentration for 1994.

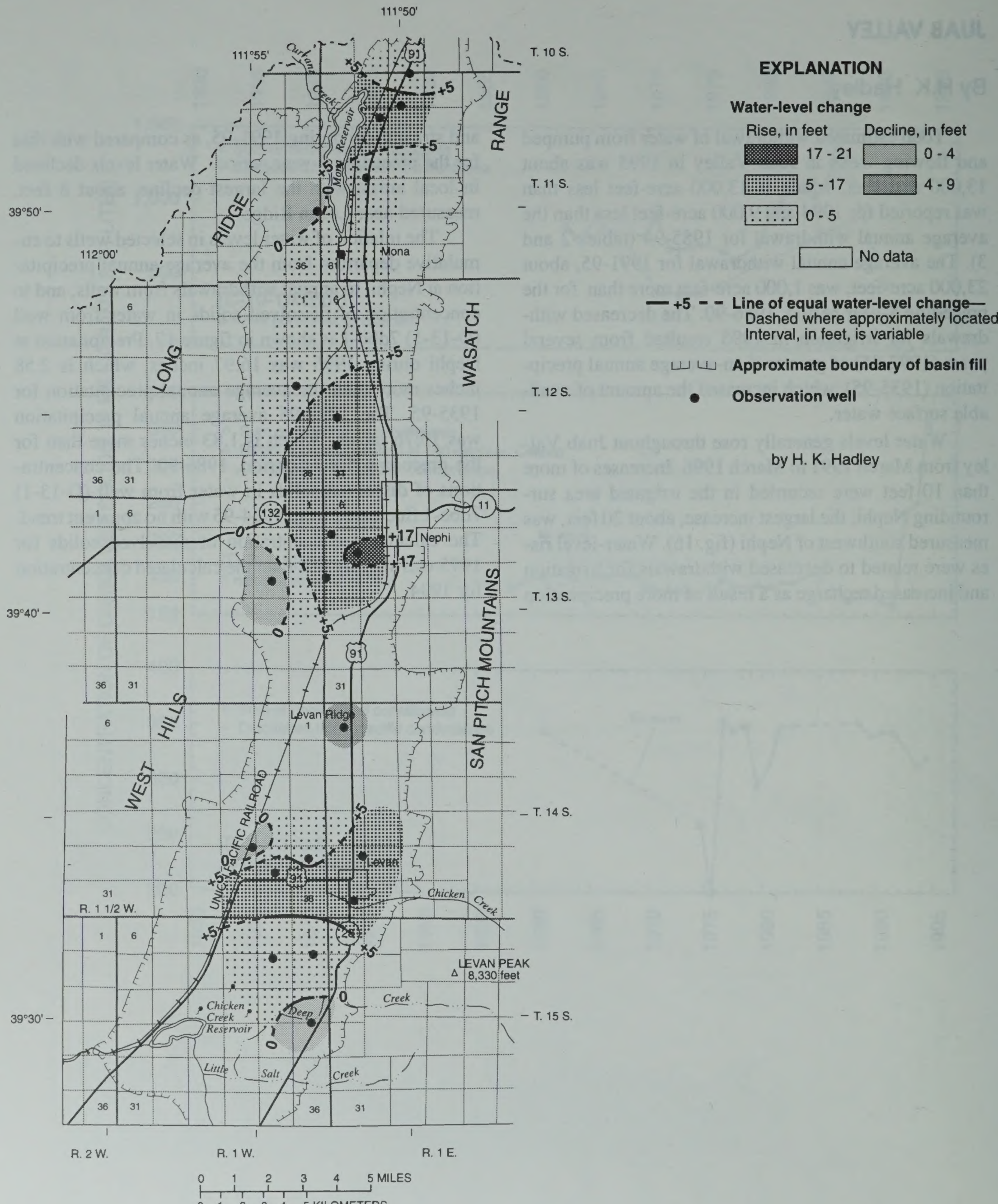


Figure 16. Map of Juab Valley showing change of water levels from March 1991 to March 1996.

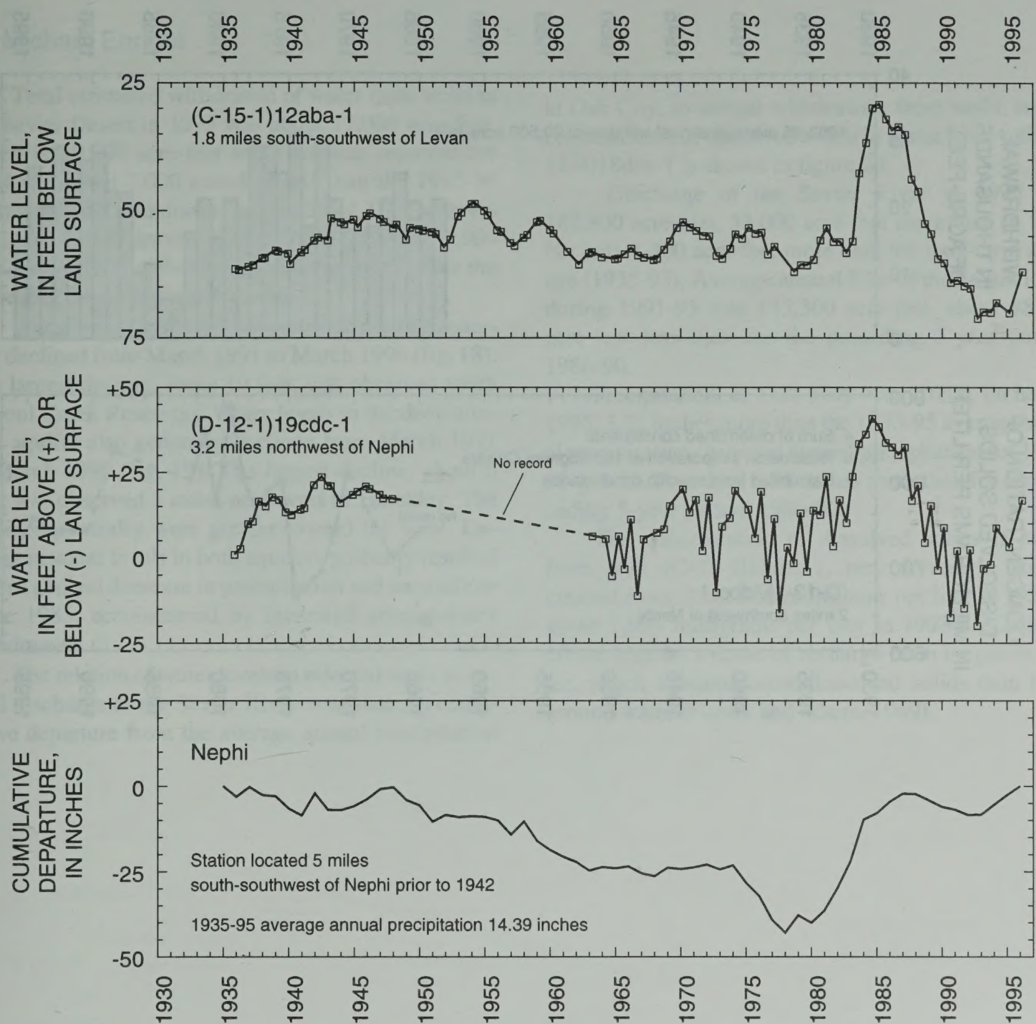


Figure 17. Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1.

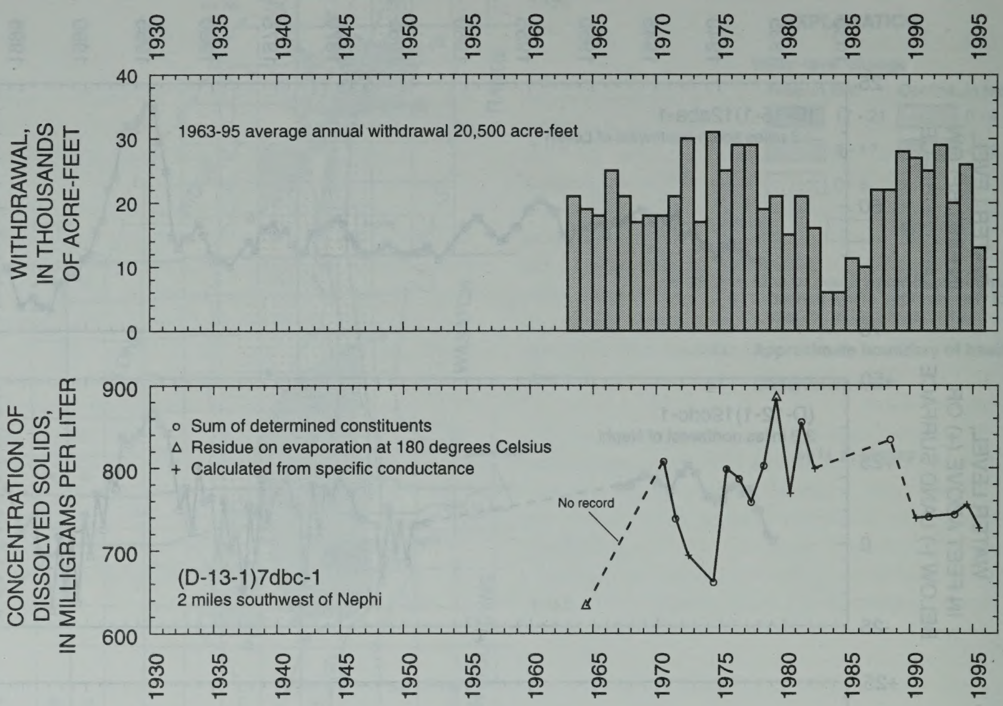


Figure 17. Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1—Continued.

SEVIER DESERT

By Michael Enright

Total estimated withdrawal of water from wells in the Sevier Desert in 1995 was about 17,000 acre-feet, which is 20,000 acre-feet less than was reported for 1994 and about 7,000 acre-feet less than the 1985-94 average annual withdrawal (tables 2 and 3). The average annual withdrawal during 1991-95 was 30,000 acre-feet, 12,000 acre-feet less than the average for the preceding 5-year period, 1986-90.

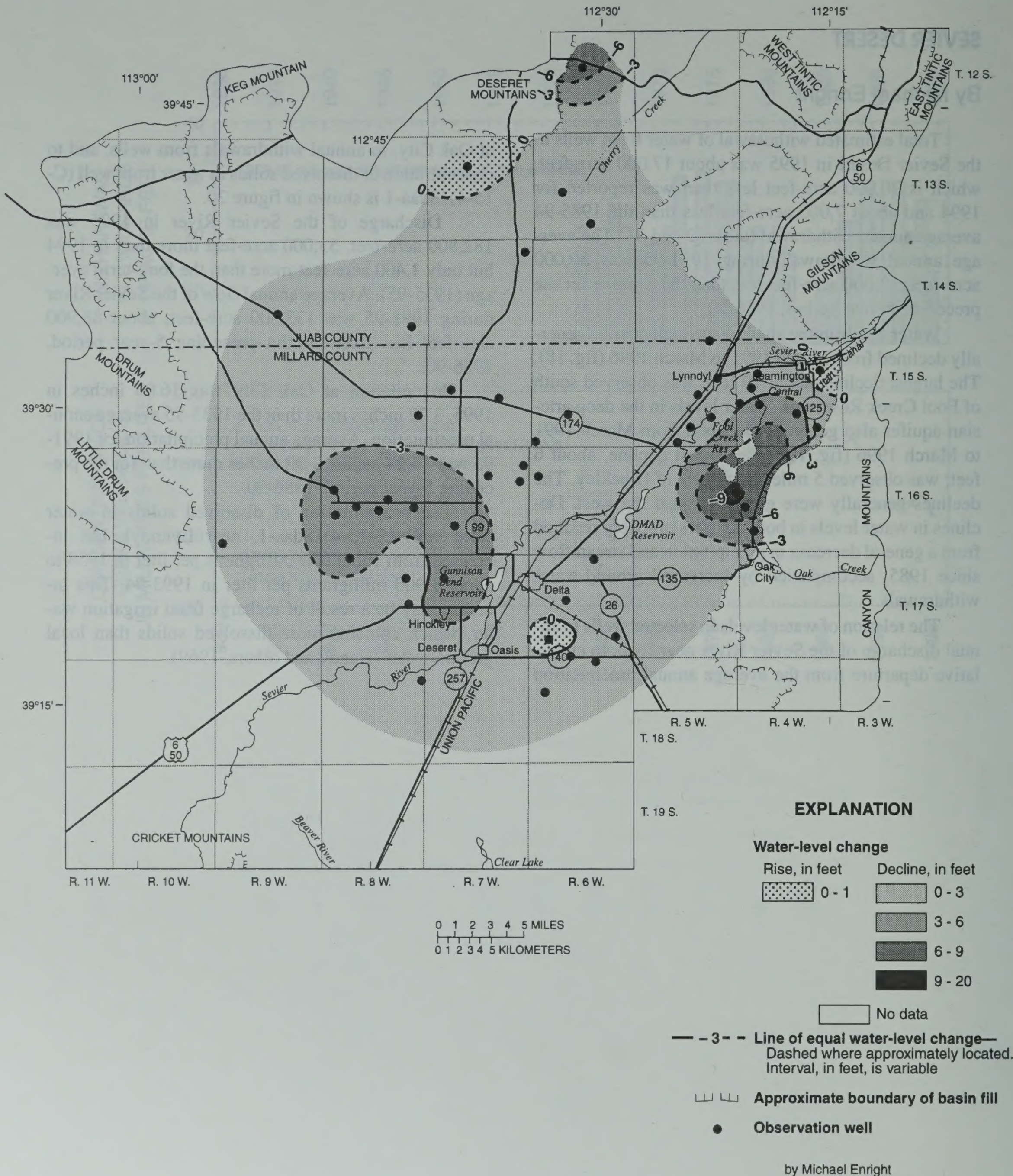
Water levels in the shallow artesian aquifer generally declined from March 1991 to March 1996 (fig. 18). The largest decline, about 19 feet, was observed south of Fool Creek Reservoir. Water levels in the deep artesian aquifer also generally declined from March 1991 to March 1996 (fig. 19). The largest decline, about 6 feet, was observed 5 miles northwest of Hinckley. The declines generally were greater toward the west. Declines in water levels in both aquifers probably resulted from a general decrease in precipitation and streamflow since 1985, accompanied by increased ground-water withdrawals.

The relation of water levels in selected wells to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1 is shown in figure 20.

Discharge of the Sevier River in 1995 was 182,800 acre-feet, 53,000 acre-feet more than in 1994 but only 1,400 acre-feet more than the long-term average (1935-95). Average annual flow of the Sevier River during 1991-95 was 133,300 acre-feet, about 88,900 acre-feet less than for the preceding 5-year period, 1986-90.

Precipitation at Oak City was 16.03 inches in 1995, 3.22 inches more than the 1935-95 average annual precipitation. Average annual precipitation for 1991-95 was 13.24 inches, 1.32 inches more than for the preceding 5-year period, 1986-90.

The concentration of dissolved solids in water from well (C-15-4)18daa-1, near Lynndyl, has increased from about 900 milligrams per liter in 1958 to about 1,900 milligrams per liter in 1993-94. This increase may be a result of recharge from irrigation water, which contains more dissolved solids than local ground water (Handy and others, 1969).



by Michael Enright

Figure 18. Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1991 to March 1996.

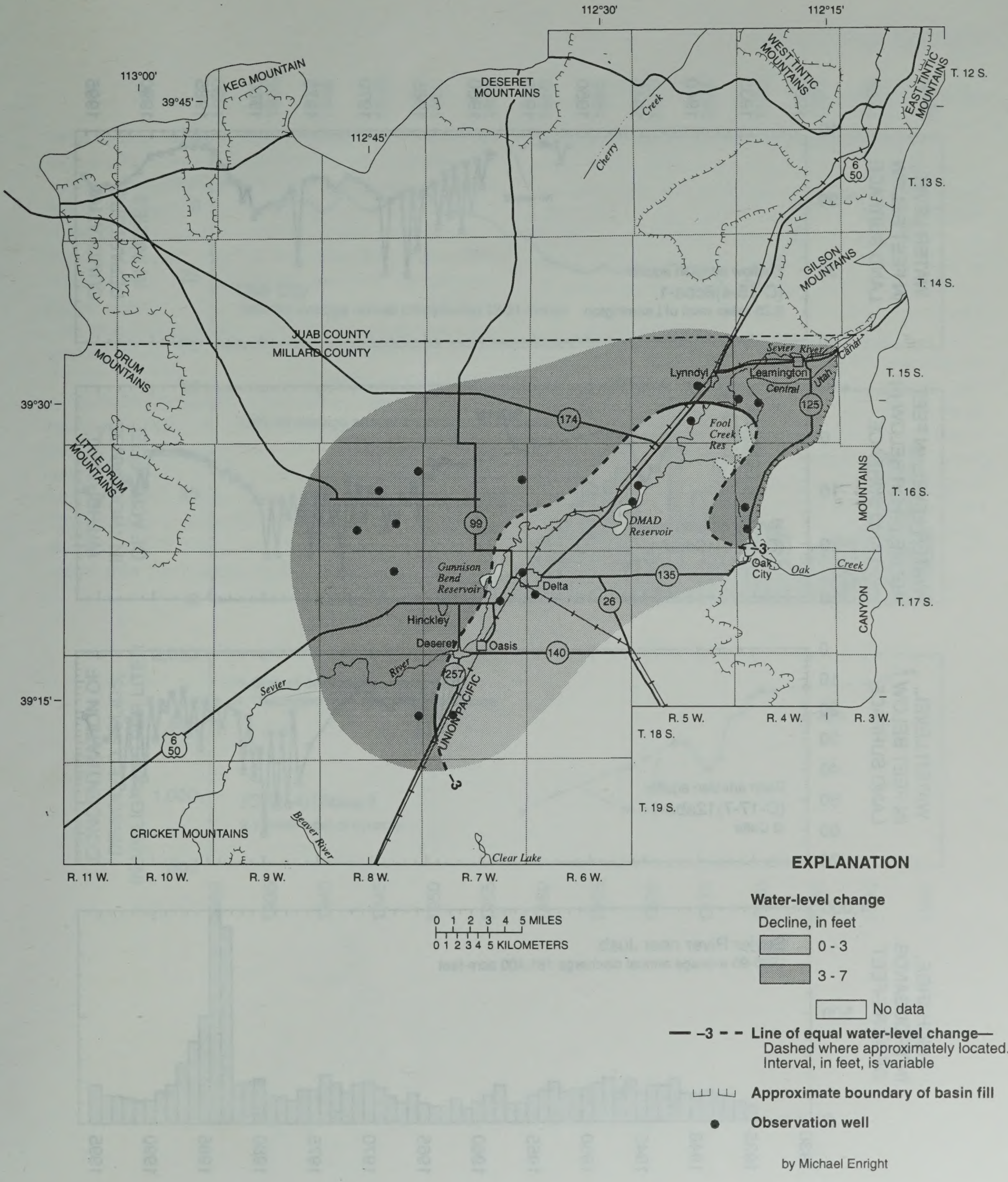


Figure 19. Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1991 to March 1996.

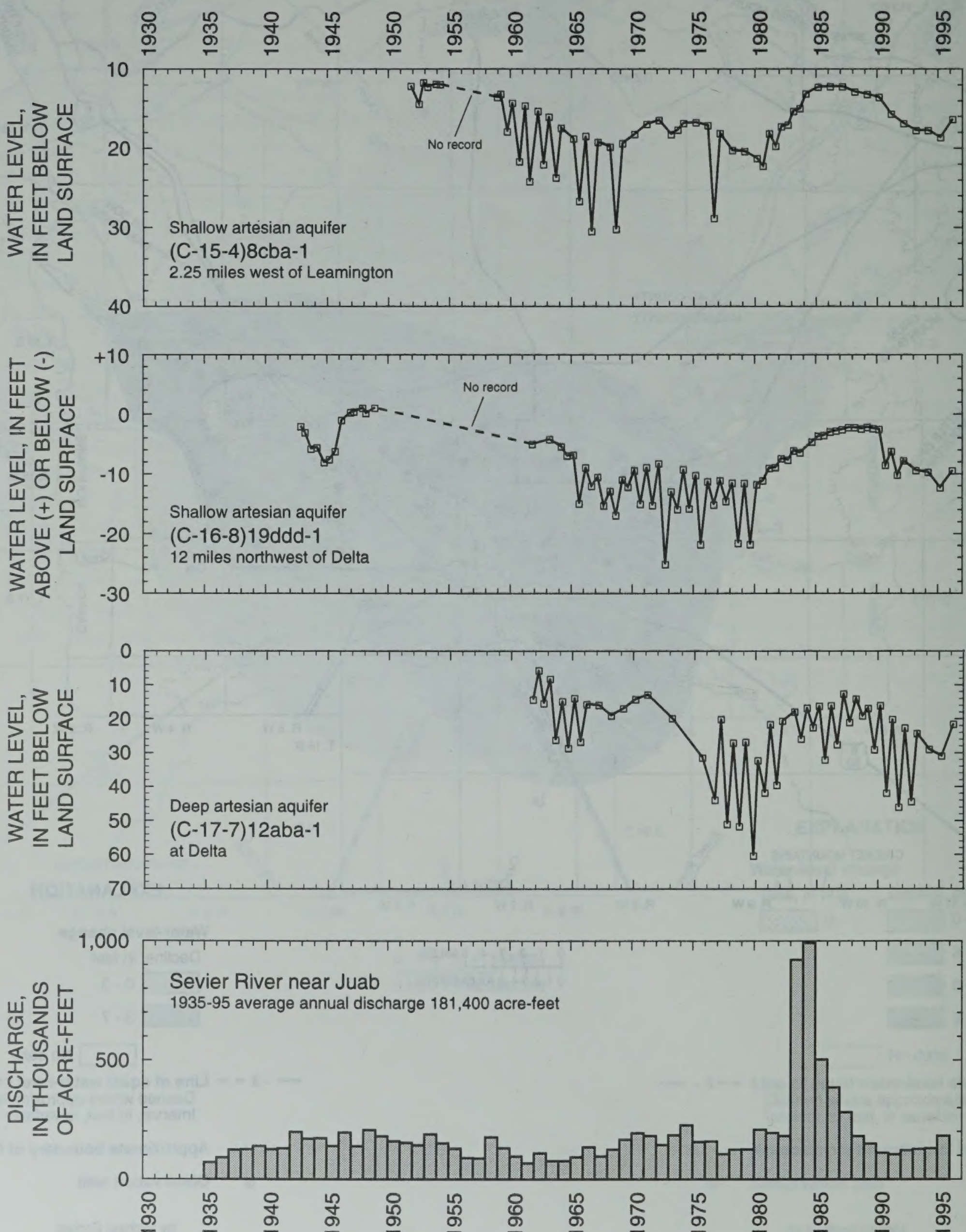


Figure 20. Relation of water levels in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1.

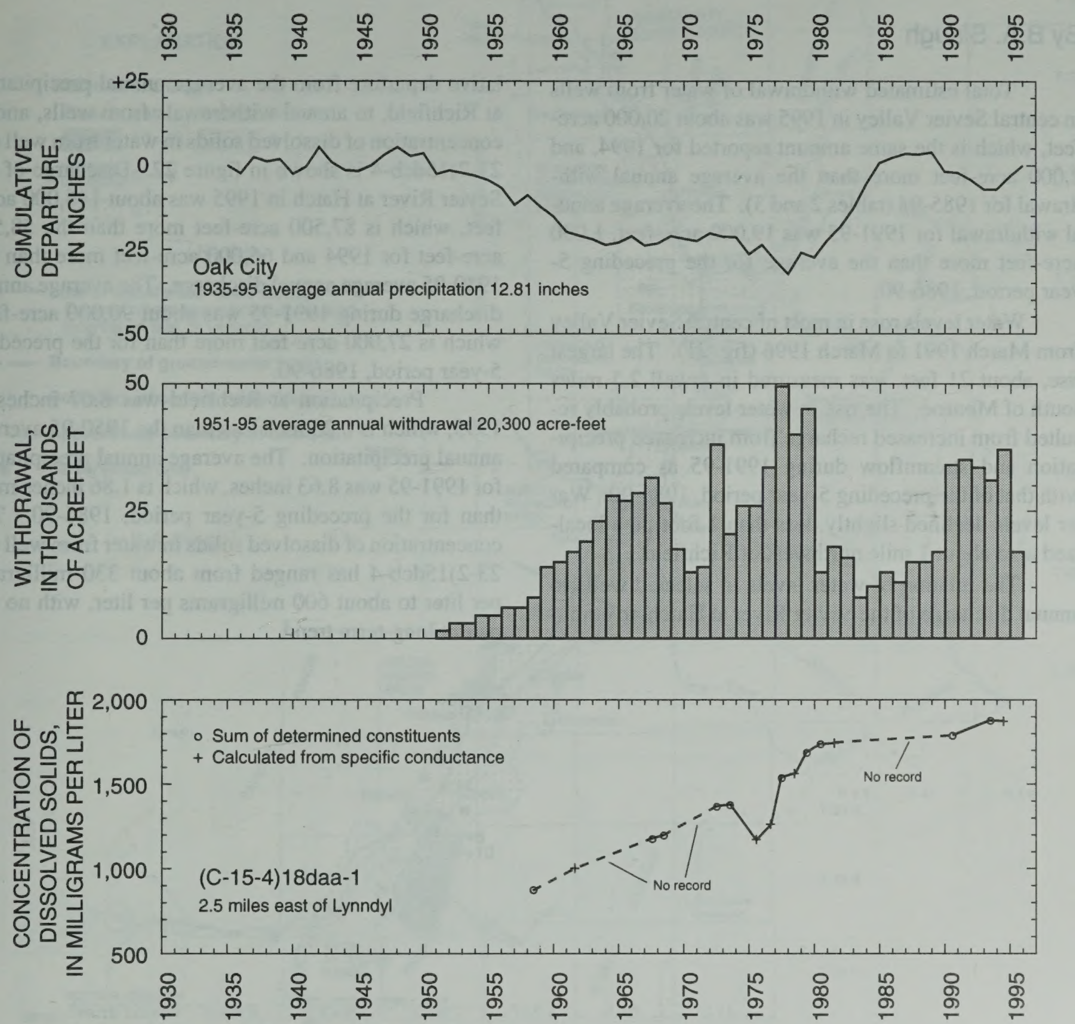


Figure 20. Relation of water levels in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.

CENTRAL SEVIER VALLEY

By B.A. Slaugh

Total estimated withdrawal of water from wells in central Sevier Valley in 1995 was about 20,000 acre-feet, which is the same amount reported for 1994, and 2,000 acre-feet more than the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95 was 19,000 acre-feet, 1,000 acre-feet more than the average for the preceding 5-year period, 1986-90.

Water levels rose in most of central Sevier Valley from March 1991 to March 1996 (fig. 21). The largest rise, about 21 feet, was measured in a well 2.5 miles south of Monroe. The rise in water levels probably resulted from increased recharge from increased precipitation and streamflow during 1991-95 as compared with that of the preceding 5-year period, 1986-90. Water levels declined slightly, less than 1 foot, in a localized area about 1 mile northwest of Richfield.

The relation of water levels in selected wells to annual discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Richfield, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 22. Discharge of the Sevier River at Hatch in 1995 was about 146,000 acre-feet, which is 87,500 acre-feet more than the 58,500 acre-feet for 1994 and 66,000 acre-feet more than the 1940-95 average annual discharge. The average annual discharge during 1991-95 was about 90,000 acre-feet, which is 27,000 acre-feet more than for the preceding 5-year period, 1986-90.

Precipitation at Richfield was 8.07 inches in 1995, which is 0.23 inch less than the 1950-95 average annual precipitation. The average annual precipitation for 1991-95 was 8.63 inches, which is 1.86 inches more than for the preceding 5-year period, 1986-90. The concentration of dissolved solids in water from well (C-23-2)15dcb-4 has ranged from about 330 milligrams per liter to about 600 milligrams per liter, with no apparent long-term trend.

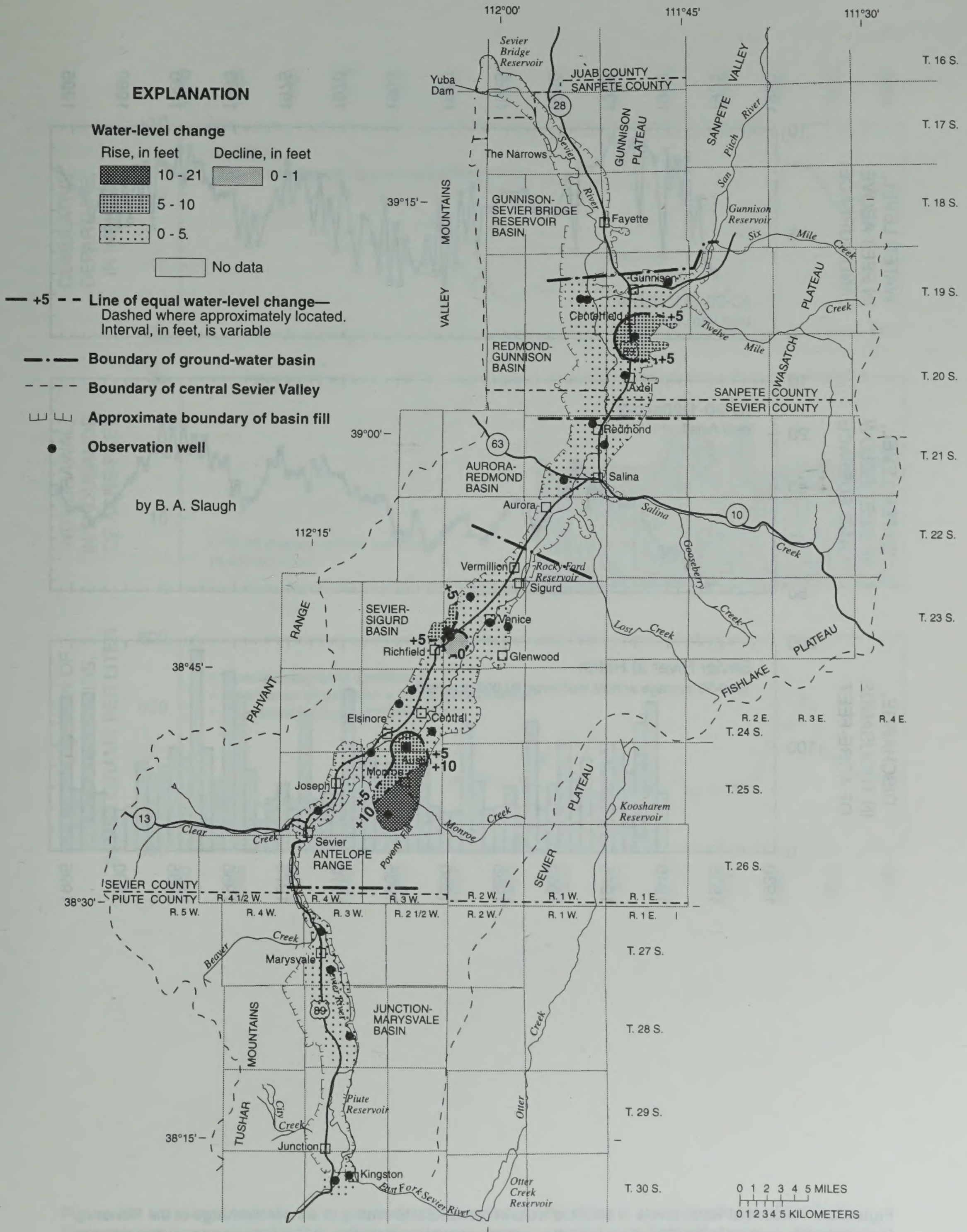


Figure 21. Map of central Sevier Valley showing change of water levels from March 1991 to March 1996.

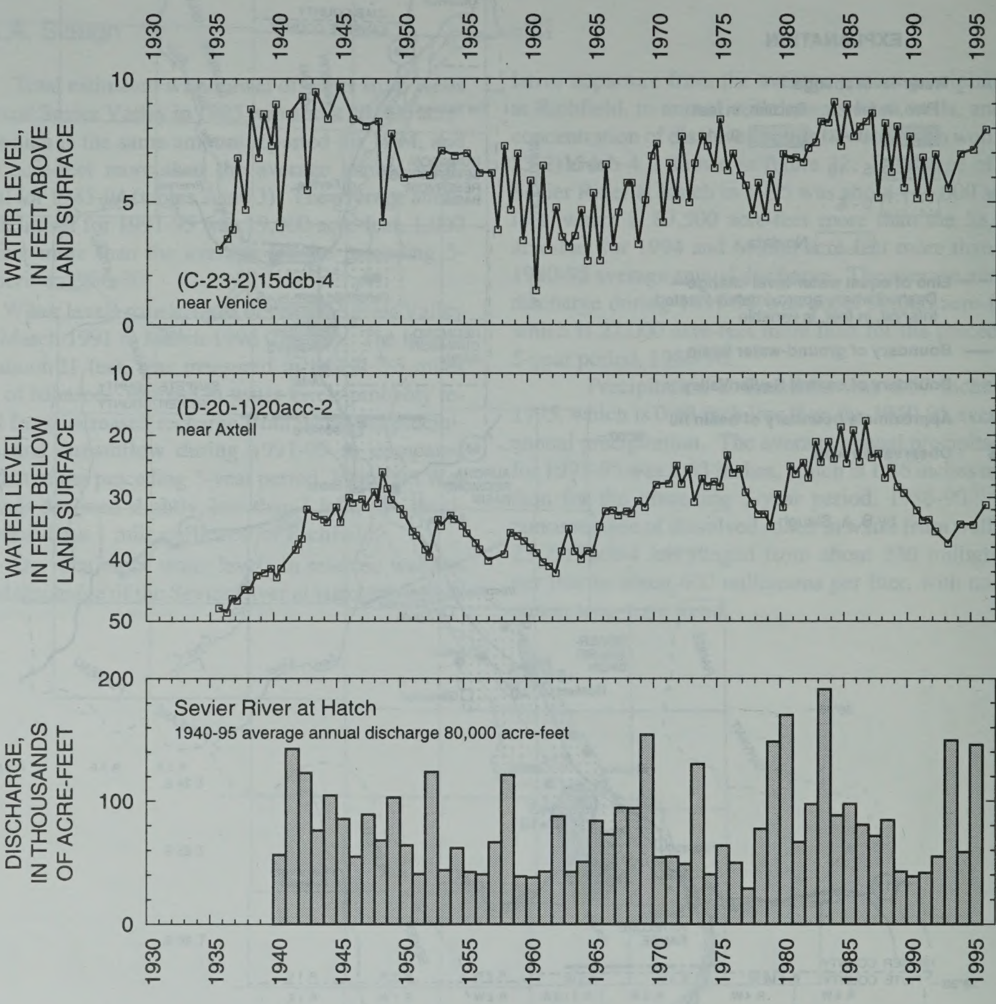


Figure 22. Relation of water levels in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Richfield, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

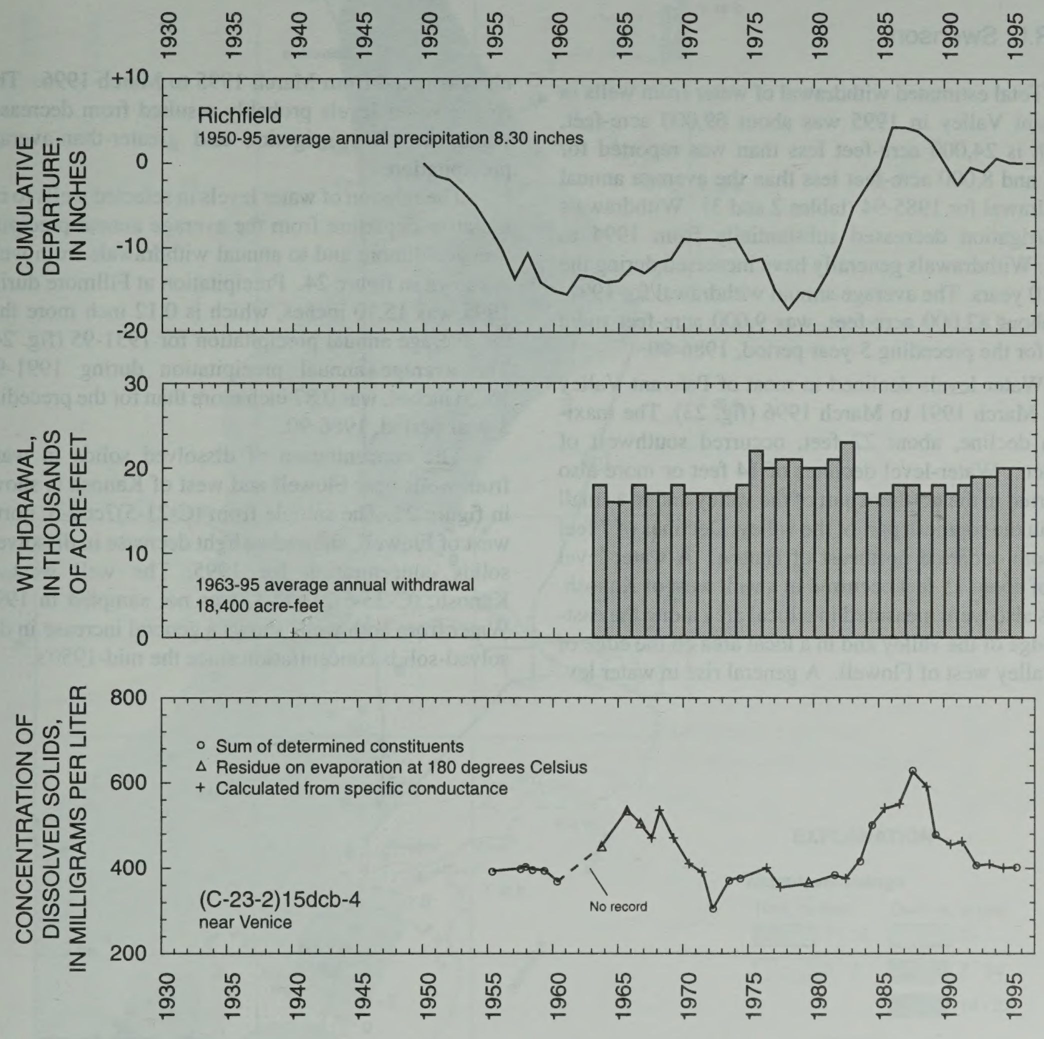


Figure 22. Relation of water levels in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Richfield, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

PAHVANT VALLEY

By R.L. Swenson

Total estimated withdrawal of water from wells in Pahvant Valley in 1995 was about 69,000 acre-feet, which is 24,000 acre-feet less than was reported for 1994 and 8,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). Withdrawals for irrigation decreased substantially from 1994 to 1995. Withdrawals generally have increased during the last 10 years. The average annual withdrawal for 1991-95, about 82,000 acre-feet, was 9,000 acre-feet more than for the preceding 5-year period, 1986-90.

Water levels declined in most of Pahvant Valley from March 1991 to March 1996 (fig. 23). The maximum decline, about 22 feet, occurred southwest of Holden. Water-level declines of 14 feet or more also occurred in the northern part of the valley and in a small area in the southern part of the valley. Declines of 7 feet or more occurred northeast of Hatton. A water-level rise of about 15 feet occurred in a well west of Kanosh. Rises also were measured in a local area along the eastern edge of the valley and in a local area on the edge of the valley west of Flowell. A general rise in water levels was noted from March 1995 to March 1996. This rise in water levels probably resulted from decreased withdrawals for irrigation and greater-than-average precipitation.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells is shown in figure 24. Precipitation at Fillmore during 1995 was 15.10 inches, which is 0.12 inch more than the average annual precipitation for 1931-95 (fig. 24). The average annual precipitation during 1991-95, 15.26 inches, was 0.87 inch more than for the preceding 5-year period, 1986-90.

The concentration of dissolved solids in water from wells near Flowell and west of Kanosh is shown in figure 25. The sample from (C-21-5)7cdd-3, northwest of Flowell, showed a slight decrease in dissolved-solids concentration for 1995. The well west of Kanosh, (C-23-6)21bdd-1, was not sampled in 1995. Water from both wells shows a general increase in dissolved-solids concentration since the mid-1950's.

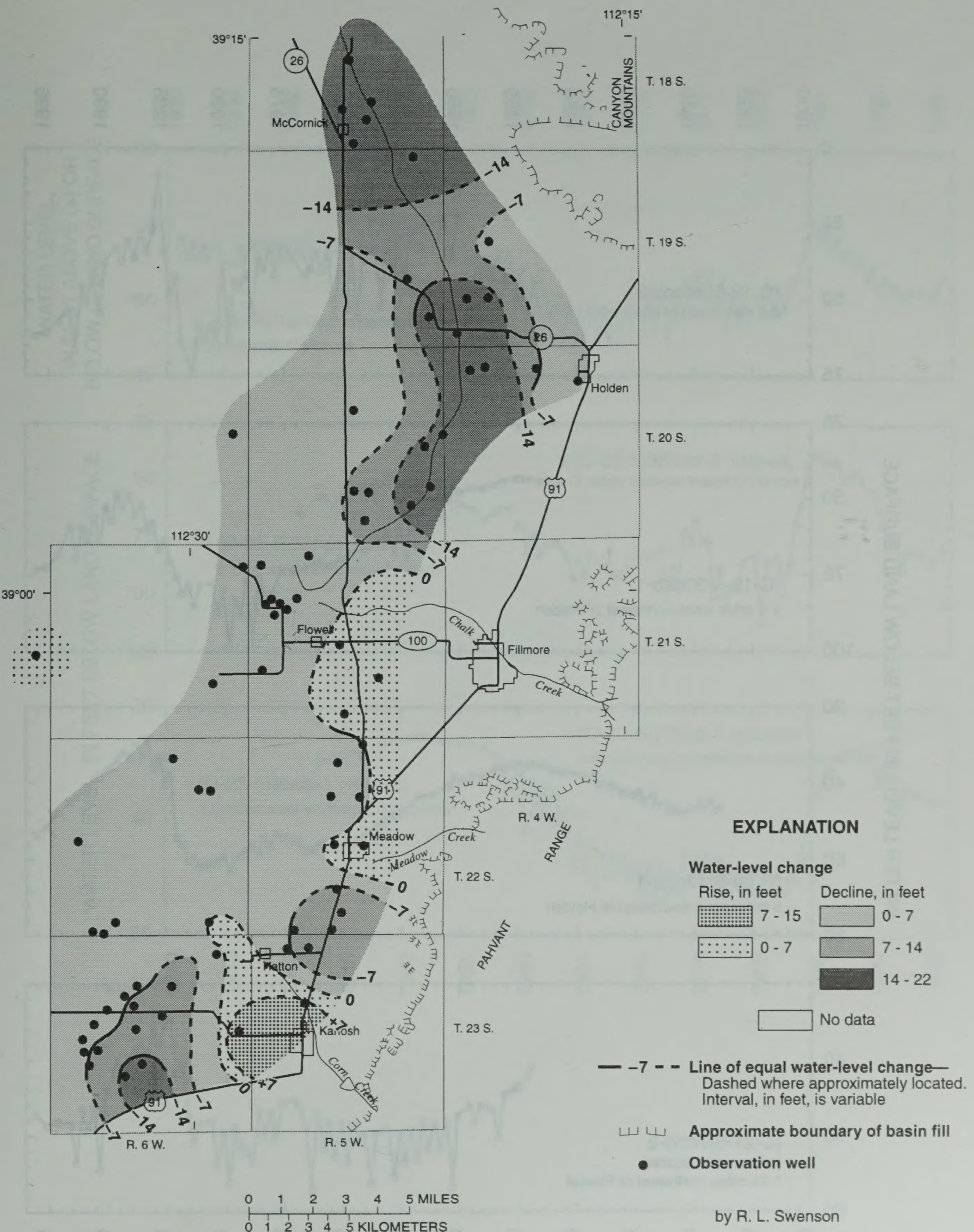


Figure 23. Map of Pahvant Valley showing change of water levels from March 1991 to March 1996.

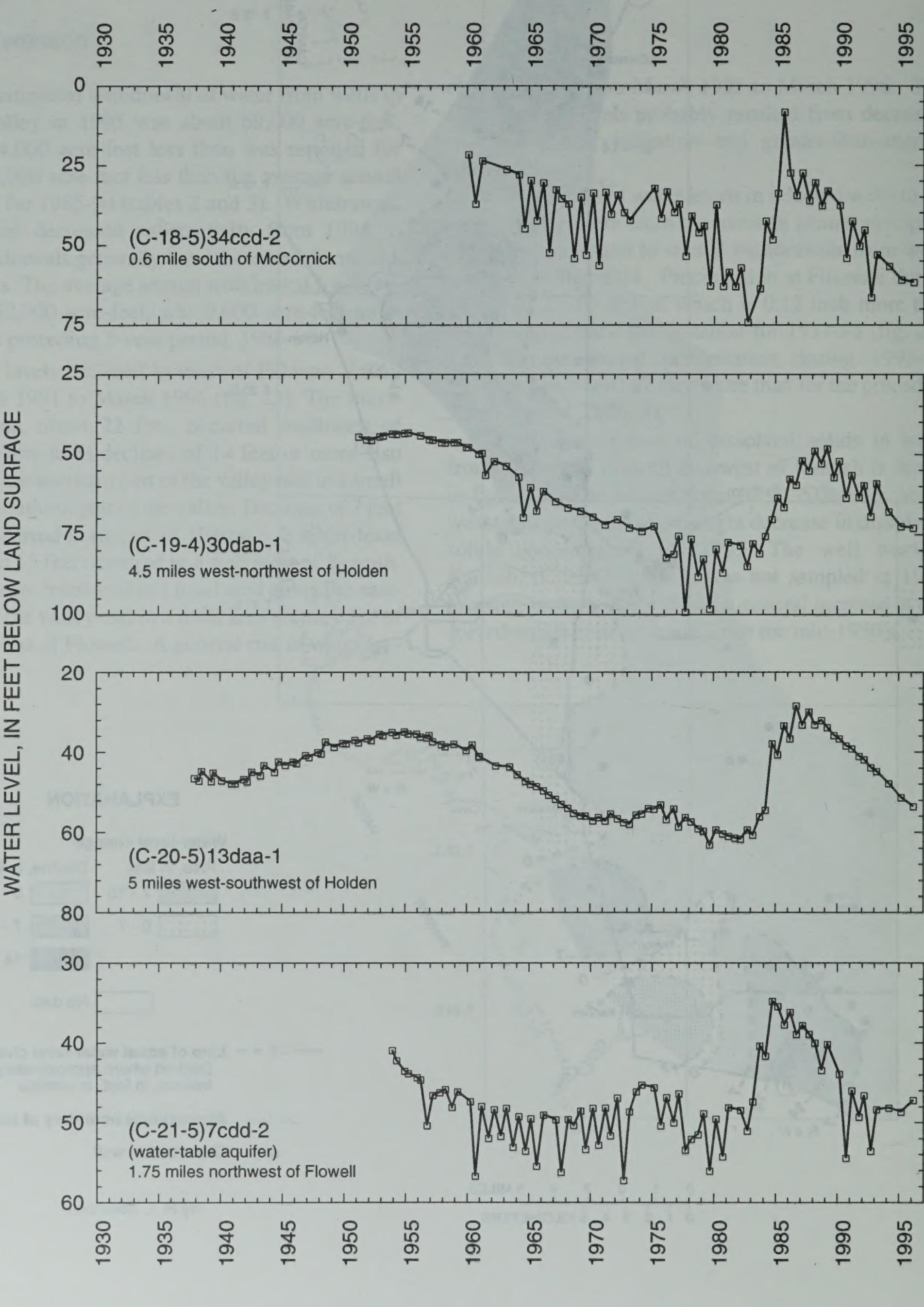


Figure 24. Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells.

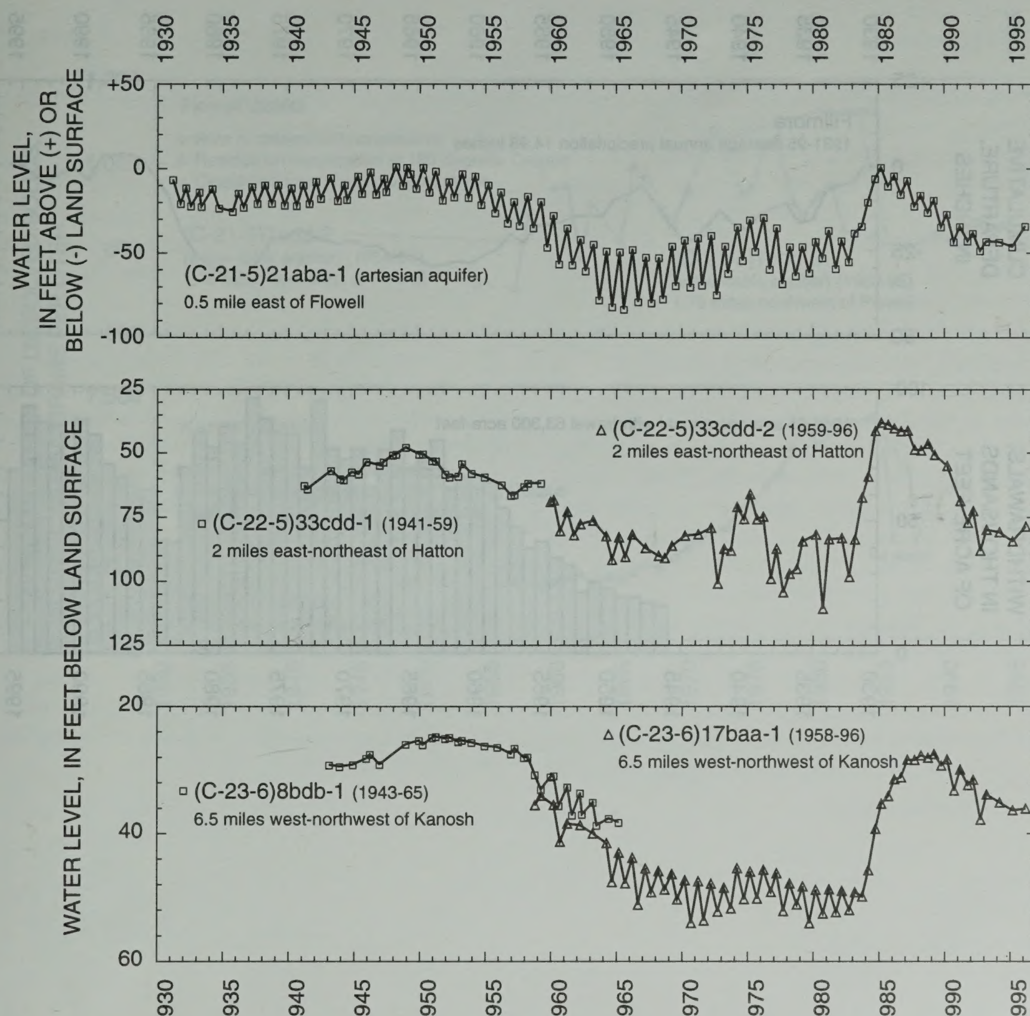


Figure 24. Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells—Continued.

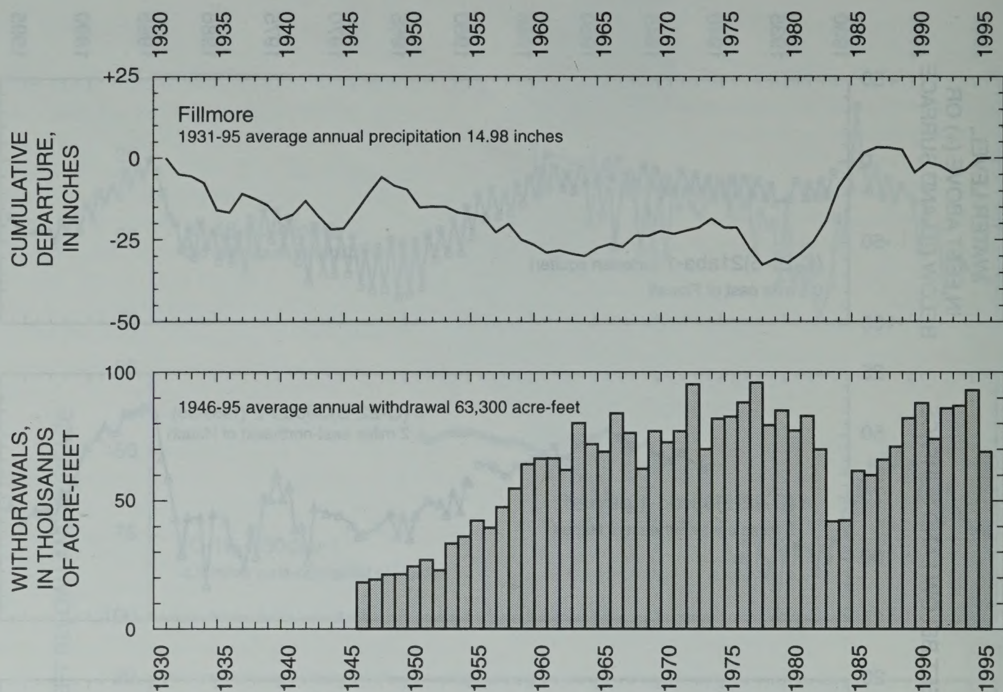


Figure 24. Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells—Continued.

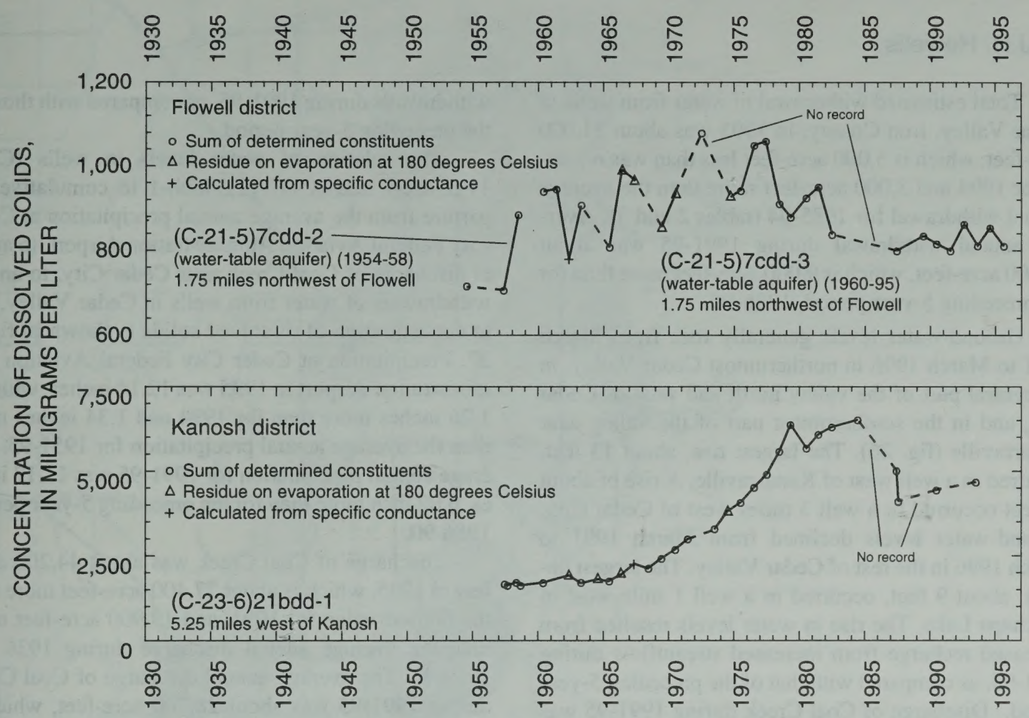


Figure 25. Concentration of dissolved solids in water from selected wells in Pahvant Valley.

CEDAR VALLEY, IRON COUNTY

By J.H. Howells

Total estimated withdrawal of water from wells in Cedar Valley, Iron County, in 1995 was about 31,000 acre-feet, which is 3,000 acre-feet less than was reported for 1994 and 3,000 acre-feet more than the average annual withdrawal for 1985-94 (tables 2 and 3). Average annual withdrawal during 1991-95 was about 33,000 acre-feet, which is 9,000 acre-feet more than for the preceding 5-year period, 1986-90.

Ground-water levels generally rose from March 1991 to March 1996 in northernmost Cedar Valley, in the central part of the valley north and west of Cedar City, and in the southernmost part of the valley near Kanarraville (fig. 26). The largest rise, about 13 feet, occurred in a well west of Kanarraville. A rise of about 11 feet occurred in a well 3 miles west of Cedar City. Ground-water levels declined from March 1991 to March 1996 in the rest of Cedar Valley. The largest decline, about 9 feet, occurred in a well 1 mile west of Quichapa Lake. The rise in water levels resulted from increased recharge from increased streamflow during 1991-95, as compared with that of the preceding 5-year period. Discharge of Coal Creek during 1991-95 was about 149 percent of the discharge during 1986-90. The water-level declines probably resulted from increased withdrawals during 1991-95, as compared with those of the preceding 5-year period.

The relation of water levels in wells (C-35-11)33aac-1 and (C-37-12)34abb-1 to cumulative departure from the average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawals of water from wells in Cedar Valley, and to concentration of dissolved solids is shown in figure 27. Precipitation at Cedar City Federal Aviation Administration Airport in 1995 was 12.14 inches, which is 1.26 inches more than for 1994 and 1.34 inches more than the average annual precipitation for 1951-95. Average annual precipitation for 1991-95 was 11.17 inches, 0.02 inch more than for the preceding 5-year period, 1986-90.

Discharge of Coal Creek was about 44,200 acre-feet in 1995, which is about 27,400 acre-feet more than the revised value for 1994, and 19,900 acre-feet more than the average annual discharge during 1936 and 1939-95. The average annual discharge of Coal Creek during 1991-95 was about 28,700 acre-feet, which is about 9,400 acre-feet more than for the preceding 5-year period, 1986-90.

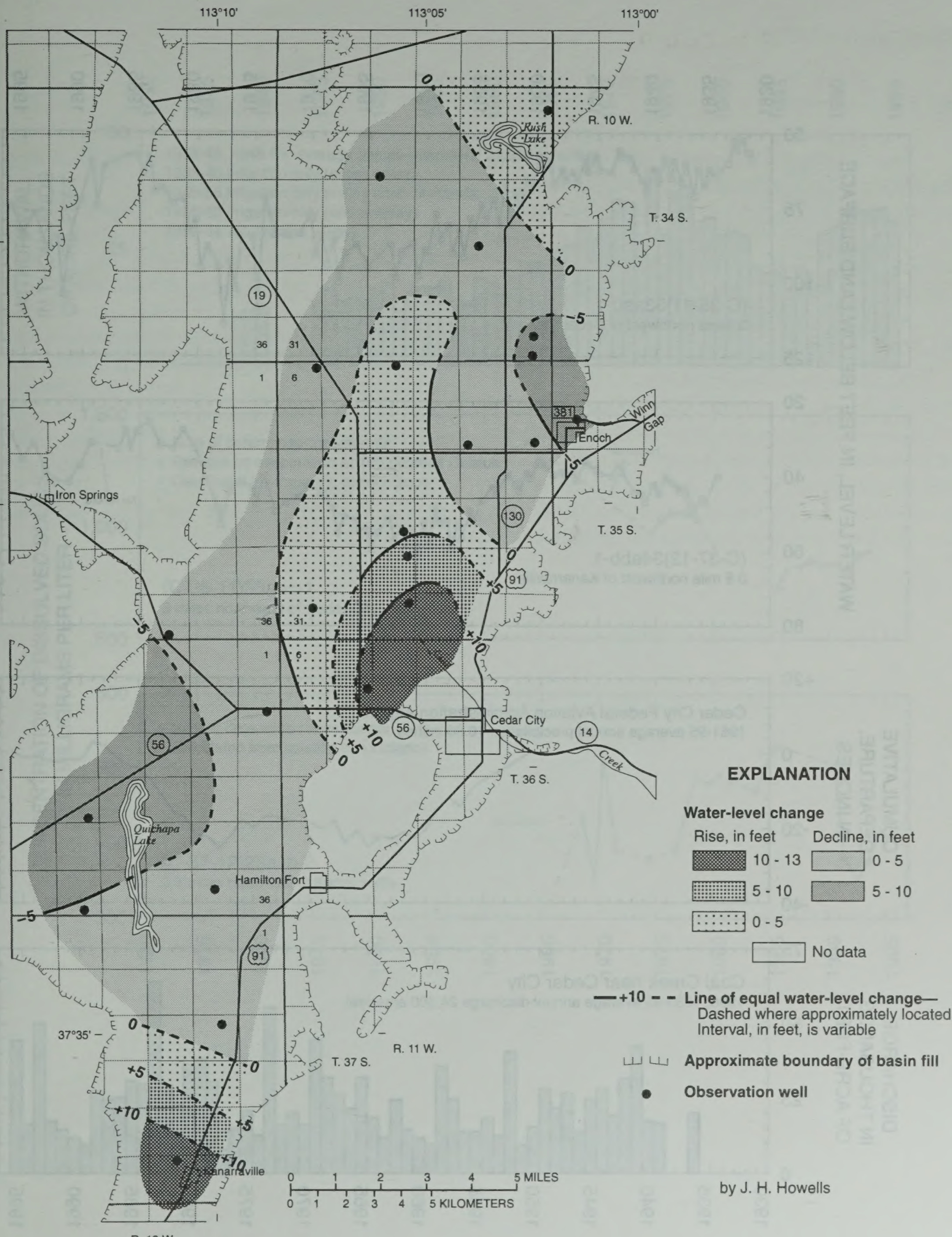


Figure 26. Map of Cedar Valley, Iron County, showing change of water levels from March 1991 to March 1996.

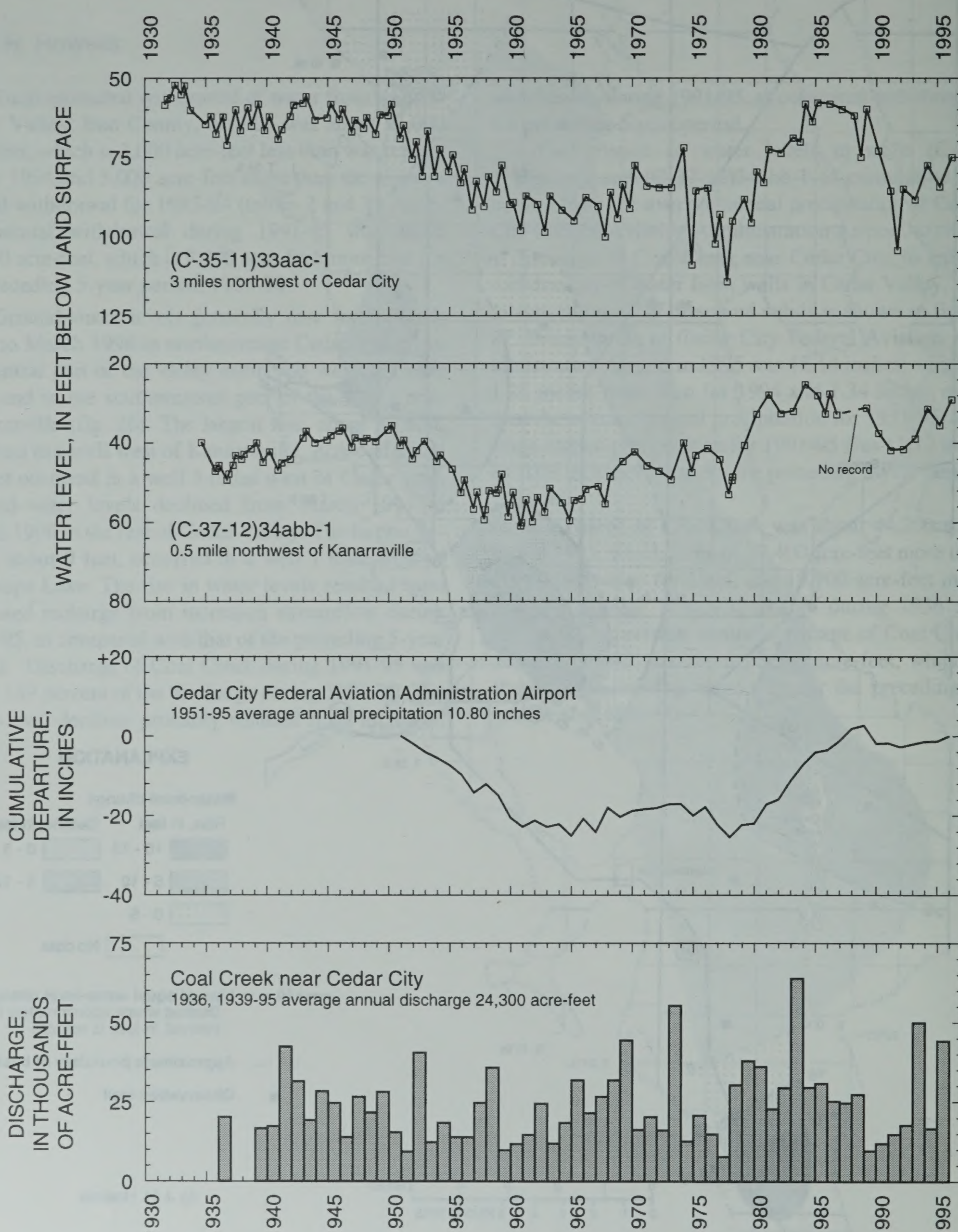


Figure 27. Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

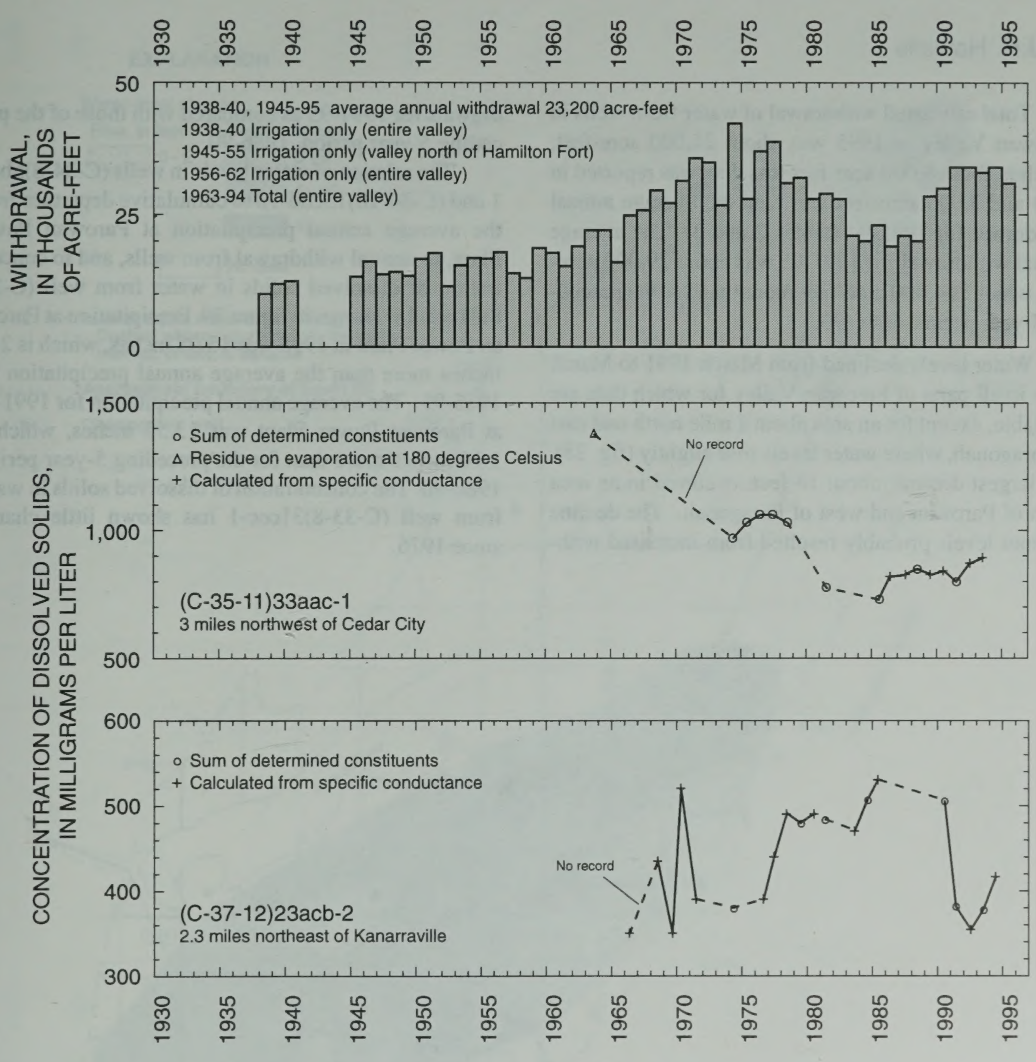


Figure 27. Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

PAROWAN VALLEY

By J.H. Howells

Total estimated withdrawal of water from wells in Parowan Valley in 1995 was about 24,000 acre-feet, which is about 6,000 acre-feet less than was reported in 1994 and 3,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95 was about 29,000 acre-feet, which is 4,000 acre-feet more than for the preceding 5-year period, 1986-90.

Water levels declined from March 1991 to March 1996 in all parts of Parowan Valley for which data are available, except for an area about 1 mile north and east of Paragonah, where water levels rose slightly (fig. 28). The largest decline, about 18 feet, occurred in an area north of Parowan and west of Paragonah. The decline in water levels probably resulted from increased withdrawals for 1991-95 as compared with those of the preceding 5-year period, 1986-90.

The relation of water levels in wells (C-34-8)5bca-1 and (C-34-10)13cbd-12 to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 29. Precipitation at Parowan Power Plant in 1995 was 15.08 inches, which is 2.62 inches more than the average annual precipitation for 1935-95. The average annual precipitation for 1991-95 at Parowan Power Plant was 13.55 inches, which is 1.10 inches more than for the preceding 5-year period, 1986-90. The concentration of dissolved solids in water from well (C-33-8)31ccc-1 has shown little change since 1976.

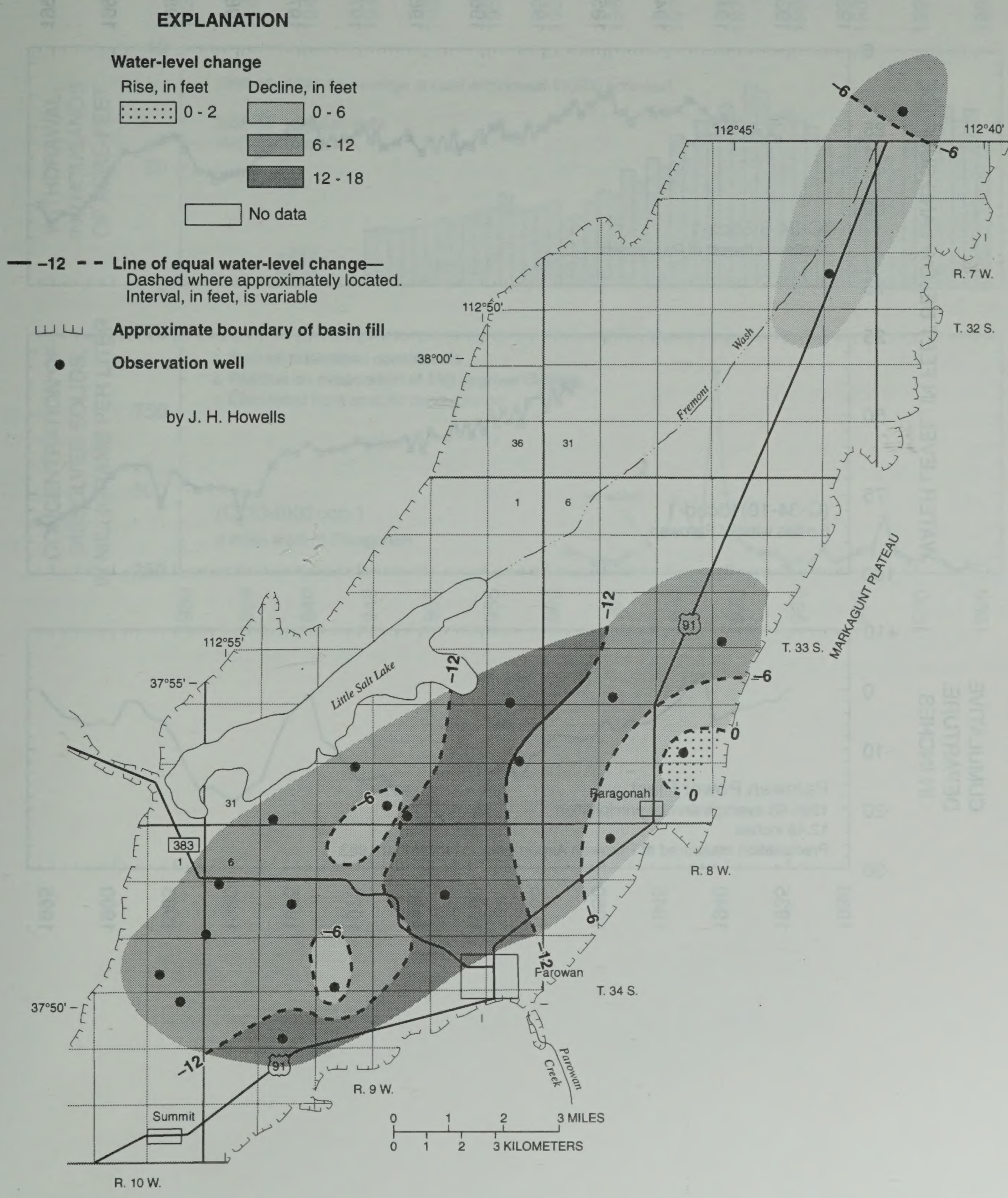


Figure 28. Map of Parowan Valley showing change of water levels from March 1991 to March 1996.

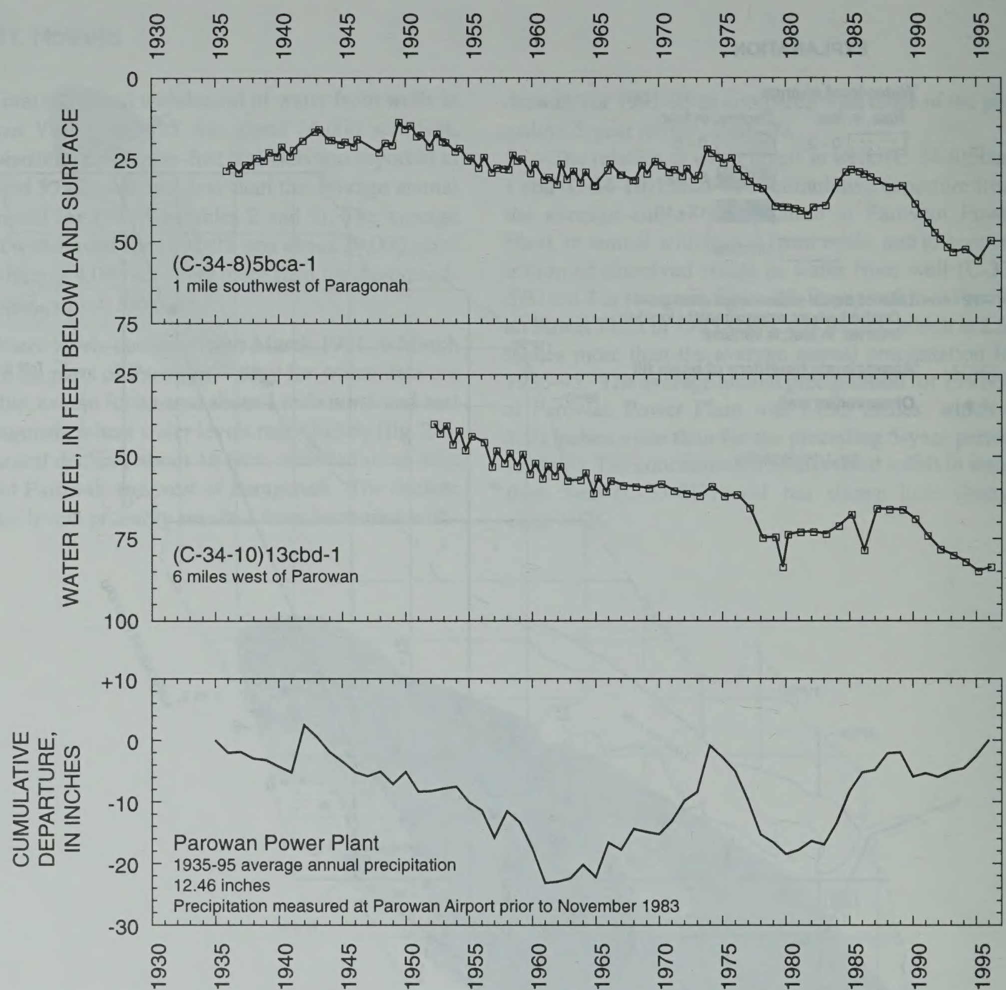


Figure 29. Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

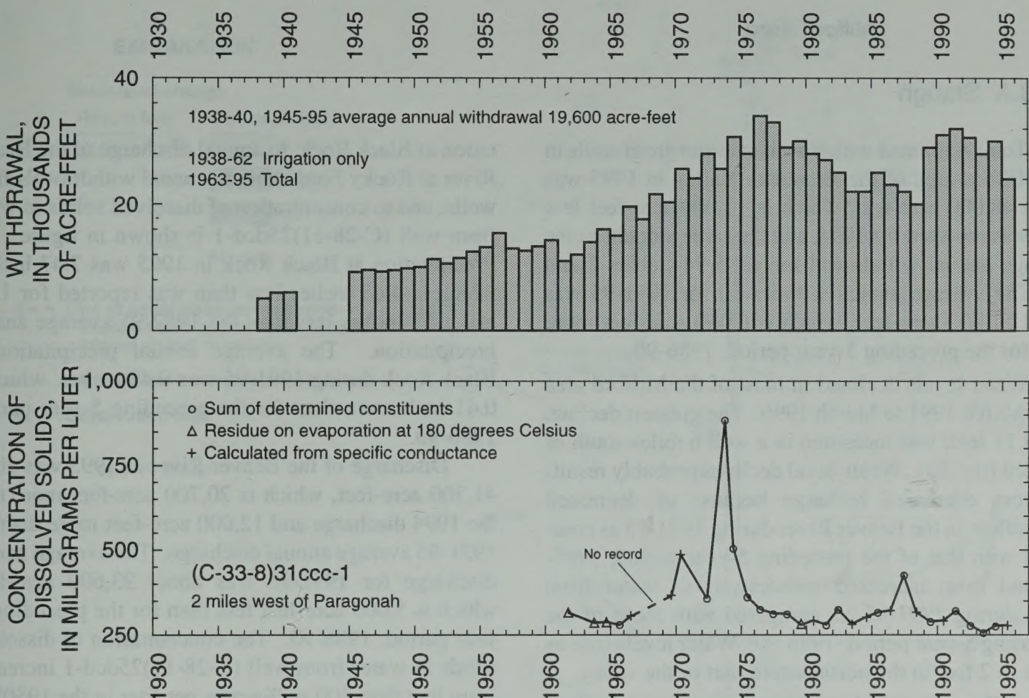


Figure 29. Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

ESCALANTE VALLEY

Milford Area

By B.A. Slaugh

Total estimated withdrawal of water from wells in the Milford area of the Escalante Valley in 1995 was about 48,000 acre-feet, which is 13,000 acre-feet less than was reported for 1994, and the same amount as the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95 was about 51,000 acre-feet, which is 6,000 acre-feet more than for the preceding 5-year period, 1986-90.

Water levels declined in most of the Milford area from March 1991 to March 1996. The greatest decline, about 11 feet, was measured in a well 6 miles south of Milford (fig. 30). Water-level declines probably resulted from decreased recharge because of decreased streamflow in the Beaver River during 1991-95 as compared with that of the preceding 5-year period, 1986-90; and from increased withdrawals of water from wells during 1991-95, as compared with those of the preceding 5-year period, 1986-90. Water levels rose as much as 2 feet in the northeastern part of the valley.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1 is shown in figure 31. Precipitation at Black Rock in 1995 was 7.47 inches, which is 4.43 inches less than was reported for 1994 and 1.51 inches less than the 1952-95 average annual precipitation. The average annual precipitation at Black Rock during 1991-95 was 9.49 inches, which is 0.41 inch more than for the preceding 5-year period, 1986-90.

Discharge of the Beaver River in 1995 was about 41,300 acre-feet, which is 20,700 acre-feet more than the 1994 discharge and 12,000 acre-feet more than the 1931-95 average annual discharge. The average annual discharge for 1991-95 was about 23,600 acre-feet, which is 5,000 acre-feet less than for the preceding 5-year period, 1986-90. The concentration of dissolved solids in water from well (C-28-11)25dcd-1 increased from less than 600 milligrams per liter in the 1950's to about 1,500 milligrams per liter in 1995.

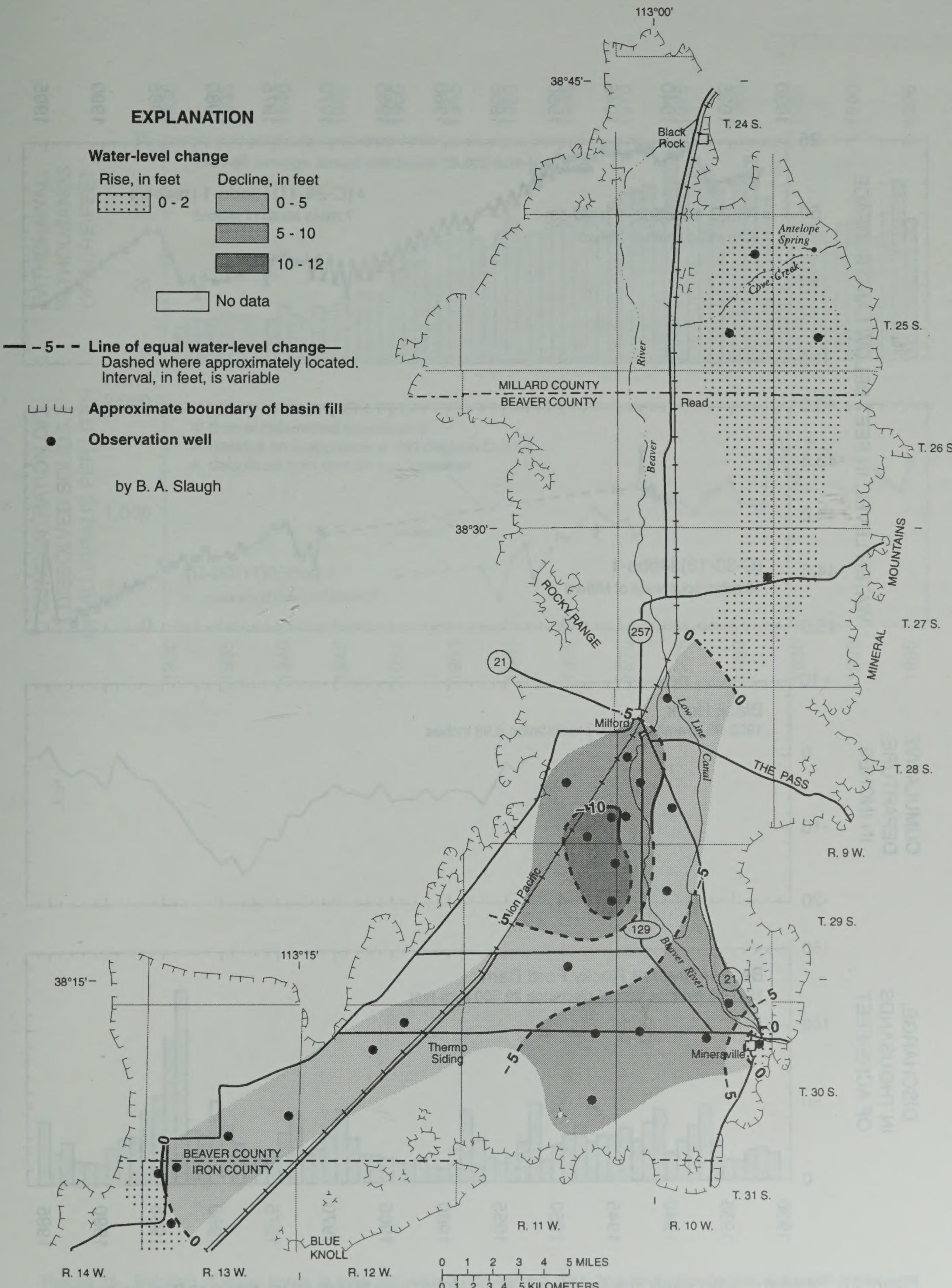


Figure 30. Map of the Milford area showing change of water levels from March 1991 to March 1996.

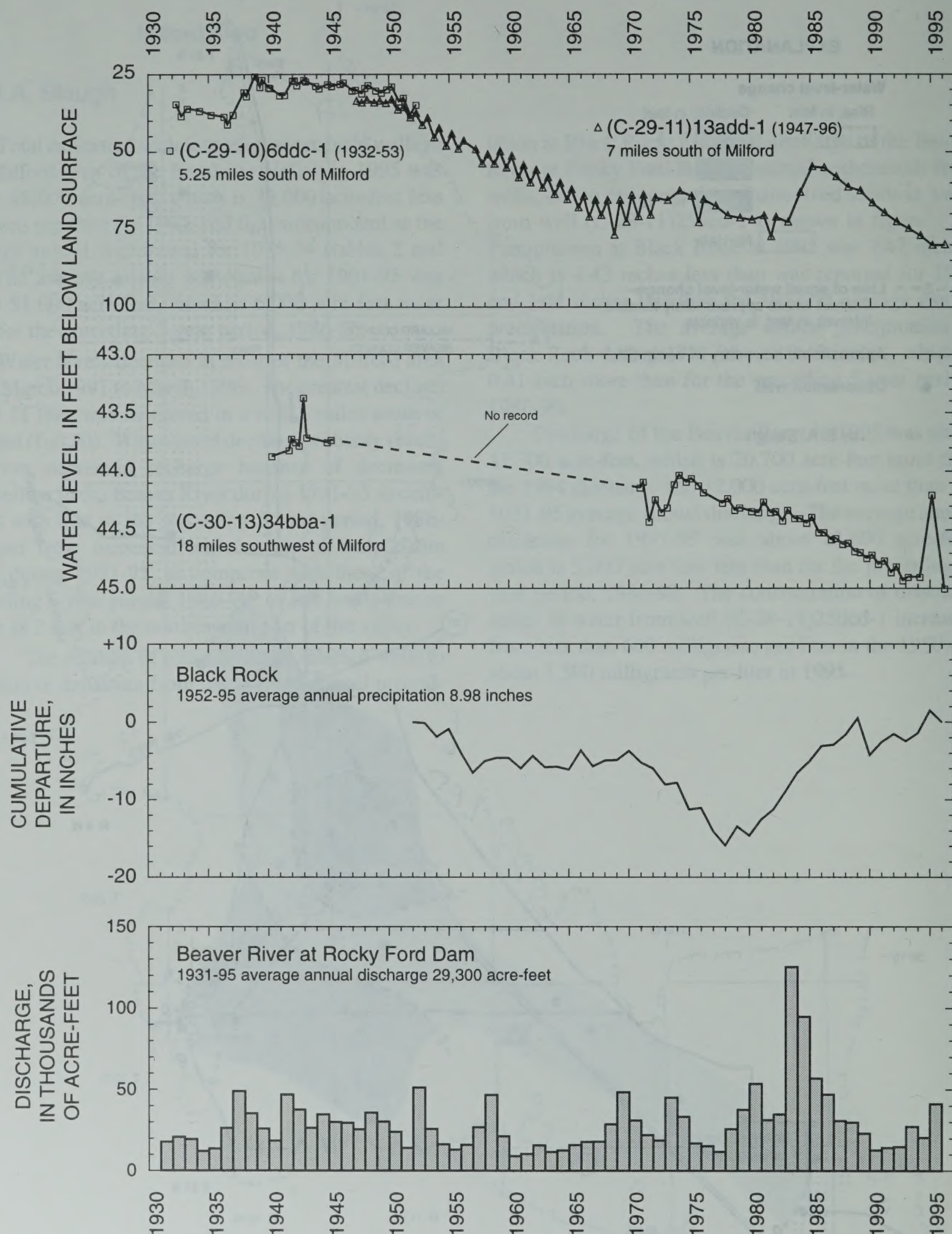


Figure 31. Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1.

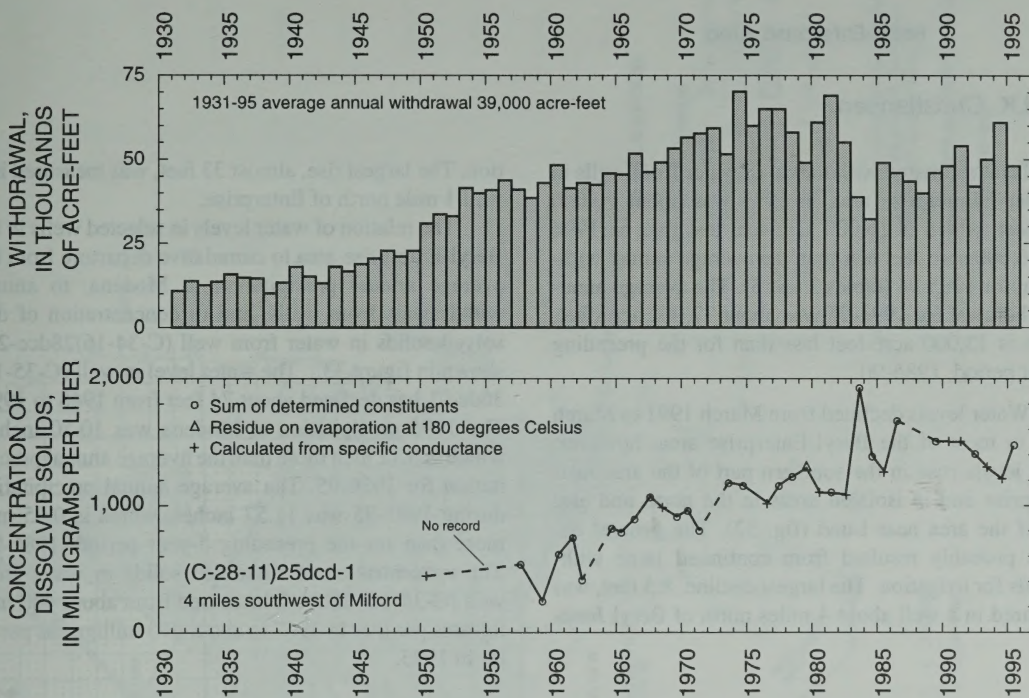


Figure 31. Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1—Continued.

ESCALANTE VALLEY

Beryl-Enterprise Area

By H.K. Christiansen

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 1995 was about 70,000 acre-feet, which is 16,000 acre-feet less than in 1994 and 16,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). The average annual withdrawal for 1991-95 was about 77,000 acre-feet, which is 13,000 acre-feet less than for the preceding 5-year period, 1986-90.

Water levels declined from March 1991 to March 1996 in most of the Beryl-Enterprise area; however, water levels rose in the southern part of the area near Enterprise and in isolated areas in the north and east part of the area near Lund (fig. 32). The general declines probably resulted from continued large withdrawals for irrigation. The largest decline, 8.5 feet, was measured in a well about 4 miles north of Beryl Junction. The largest rise, almost 33 feet, was measured in a well 1 mile north of Enterprise.

The relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 33. The water level in well (C-35-17) 36dcc-1 has declined about 74 feet from 1948 to 1995. The 1995 precipitation at Modena was 10.50 inches, which is 0.12 inch more than the average annual precipitation for 1936-95. The average annual precipitation during 1991-95 was 11.57 inches, which is 0.85 inch more than for the preceding 5-year period, 1986-90. The concentration of dissolved solids in water from well (C-34-16) 28dcc-2 increased from about 460 milligrams per liter in 1967 to about 690 milligrams per liter in 1995.

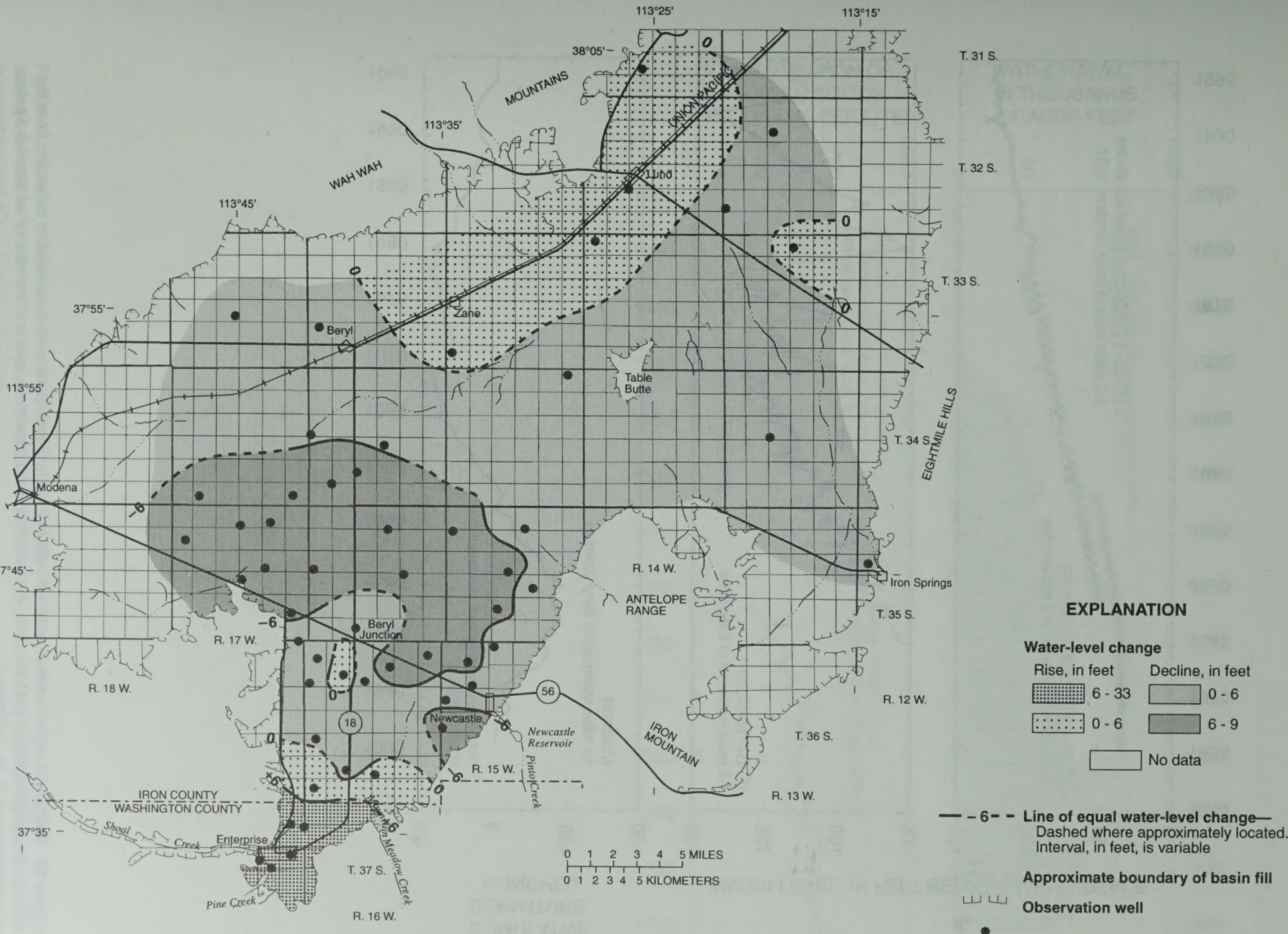


Figure 32. Map of the Beryl-Enterprise area showing change of water levels from March 1991 to March 1996.

by H. K. Christiansen

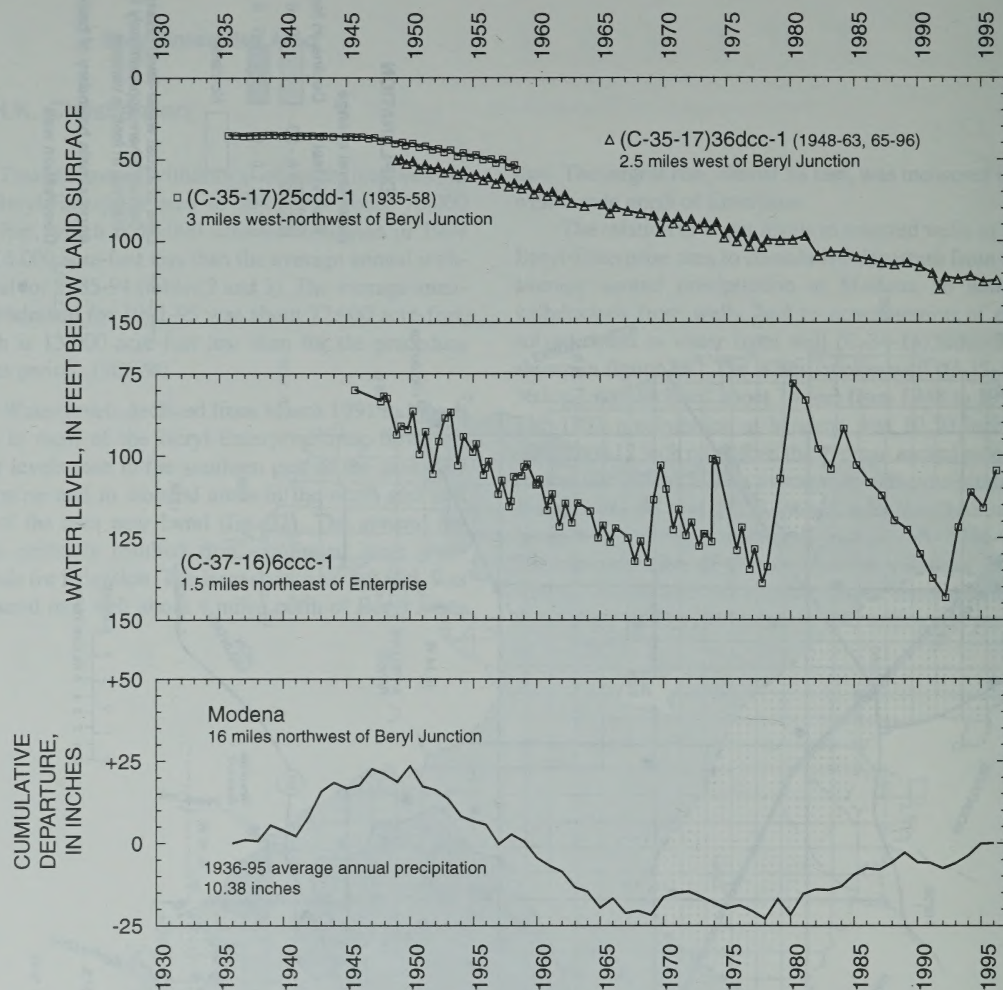


Figure 33. Relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

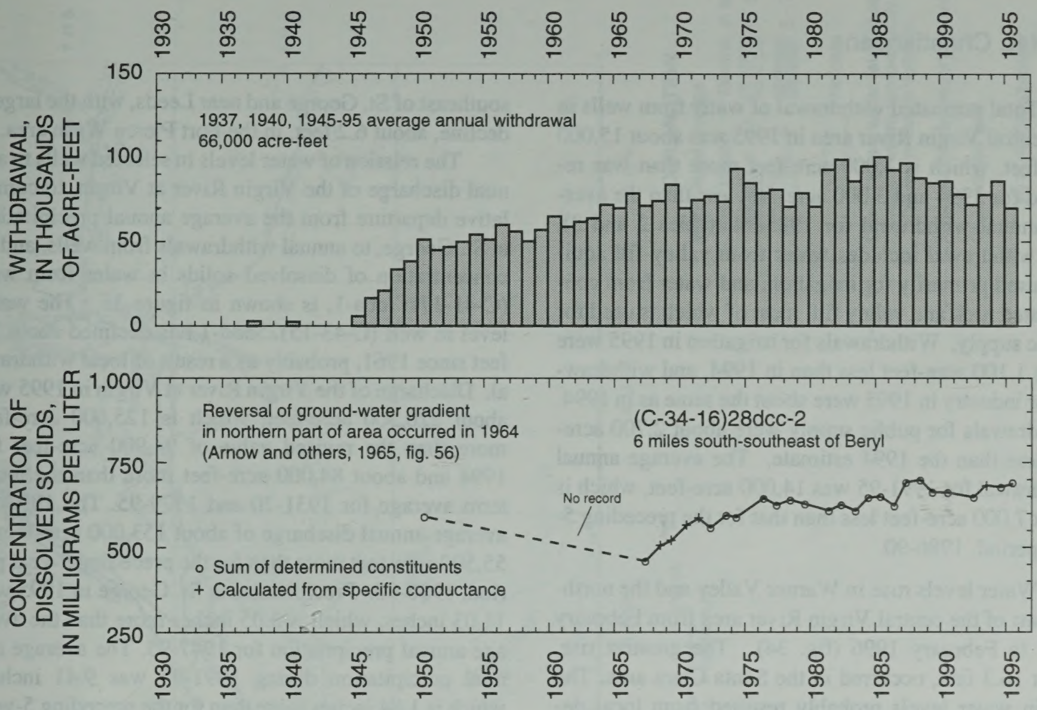


Figure 33. Relation of water levels in selected wells in the Beryl-enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

CENTRAL VIRGIN RIVER AREA

By H.K. Christiansen

Total estimated withdrawal of water from wells in the central Virgin River area in 1995 was about 15,000 acre-feet, which is 1,000 acre-feet more than was reported for 1994 and 3,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). This withdrawal includes water from valley-fill aquifers, used primarily for irrigation, and water from consolidated rock and valley fill, most of which is used for public supply. Withdrawals for irrigation in 1995 were about 1,100 acre-feet less than in 1994, and withdrawals for industry in 1995 were about the same as in 1994. Withdrawals for public supply were about 2,700 acre-feet less than the 1994 estimate. The average annual withdrawal for 1991-95 was 14,000 acre-feet, which is about 7,000 acre-feet less than that for the preceding 5-year period, 1986-90.

Water levels rose in Warner Valley and the northern part of the central Virgin River area from February 1991 to February 1996 (fig. 34). The greatest rise, about 16.3 feet, occurred in the Santa Clara area. The rise in water levels probably resulted from local decreases in withdrawal for irrigation and greater-than-average precipitation in the Santa Clara River drainage in 1995. Water levels declined in areas south and southeast of St. George and near Leeds, with the largest decline, about 6.2 feet, in the Fort Pierce Wash area.

The relation of water levels in selected wells to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1, is shown in figure 35. The water level in well (C-43-15)25ddd-1 has declined about 77 feet since 1961, probably as a result of local withdrawal. Discharge of the Virgin River at Virgin in 1995 was about 220,500 acre-feet, which is 125,600 acre-feet more than the revised value of 94,900 acre-feet for 1994 and about 84,000 acre-feet more than the long-term average for 1931-70 and 1979-95. The 1991-95 average annual discharge of about 153,000 acre-feet is 55,500 acre-feet more than for the preceding 5-year period, 1986-90. Precipitation at St. George in 1995 was 11.03 inches, which is 3.05 inches more than the average annual precipitation for 1947-95. The average annual precipitation during 1991-95 was 9.41 inches, which is 1.84 inches more than for the preceding 5-year period, 1986-90. The graph of concentration of dissolved solids in water from well (C-41-17)17cba-1 indicates little overall change since 1966.

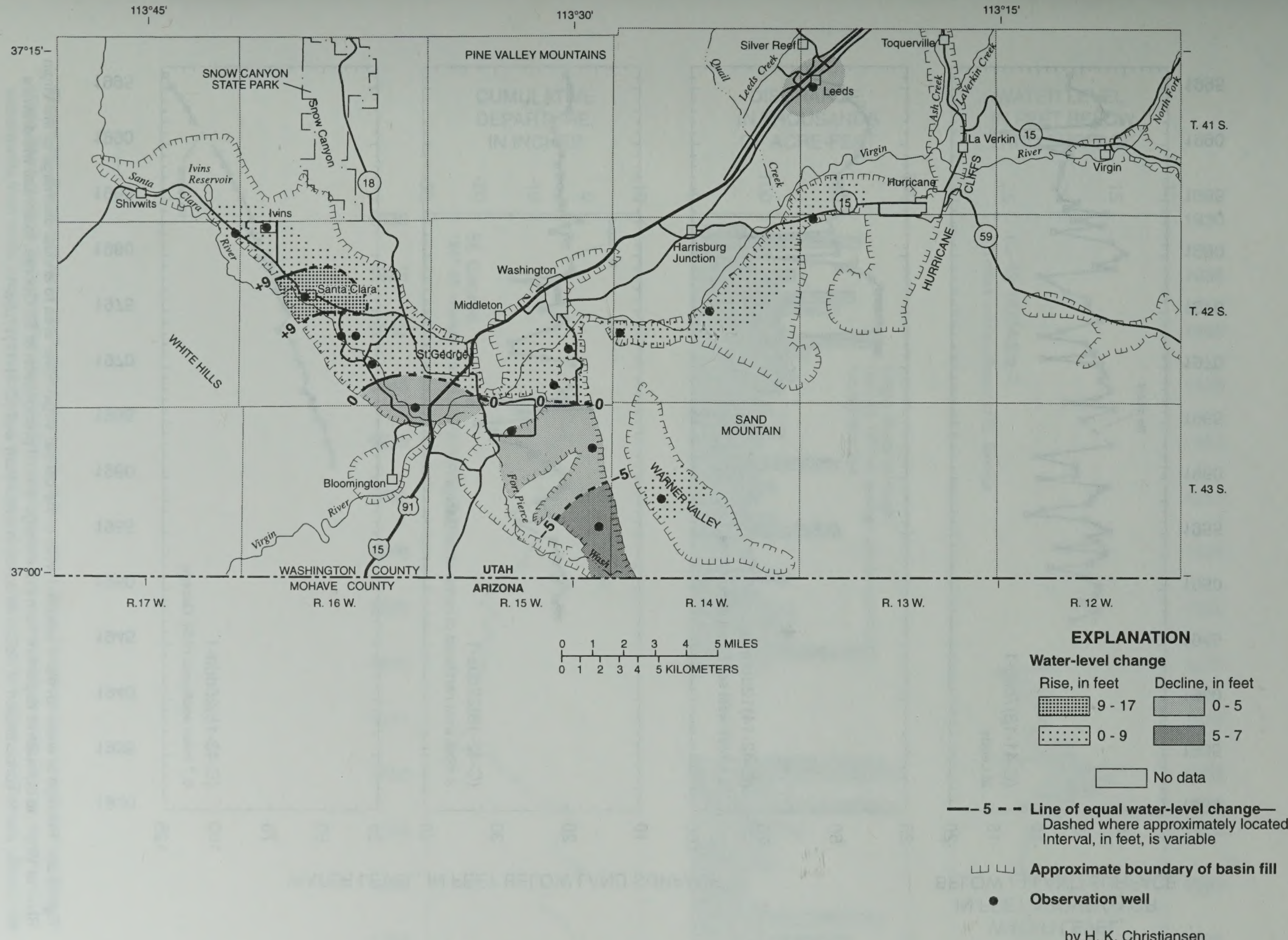


Figure 34. Map of the central Virgin River area showing change of water levels from February 1991 to February 1996.

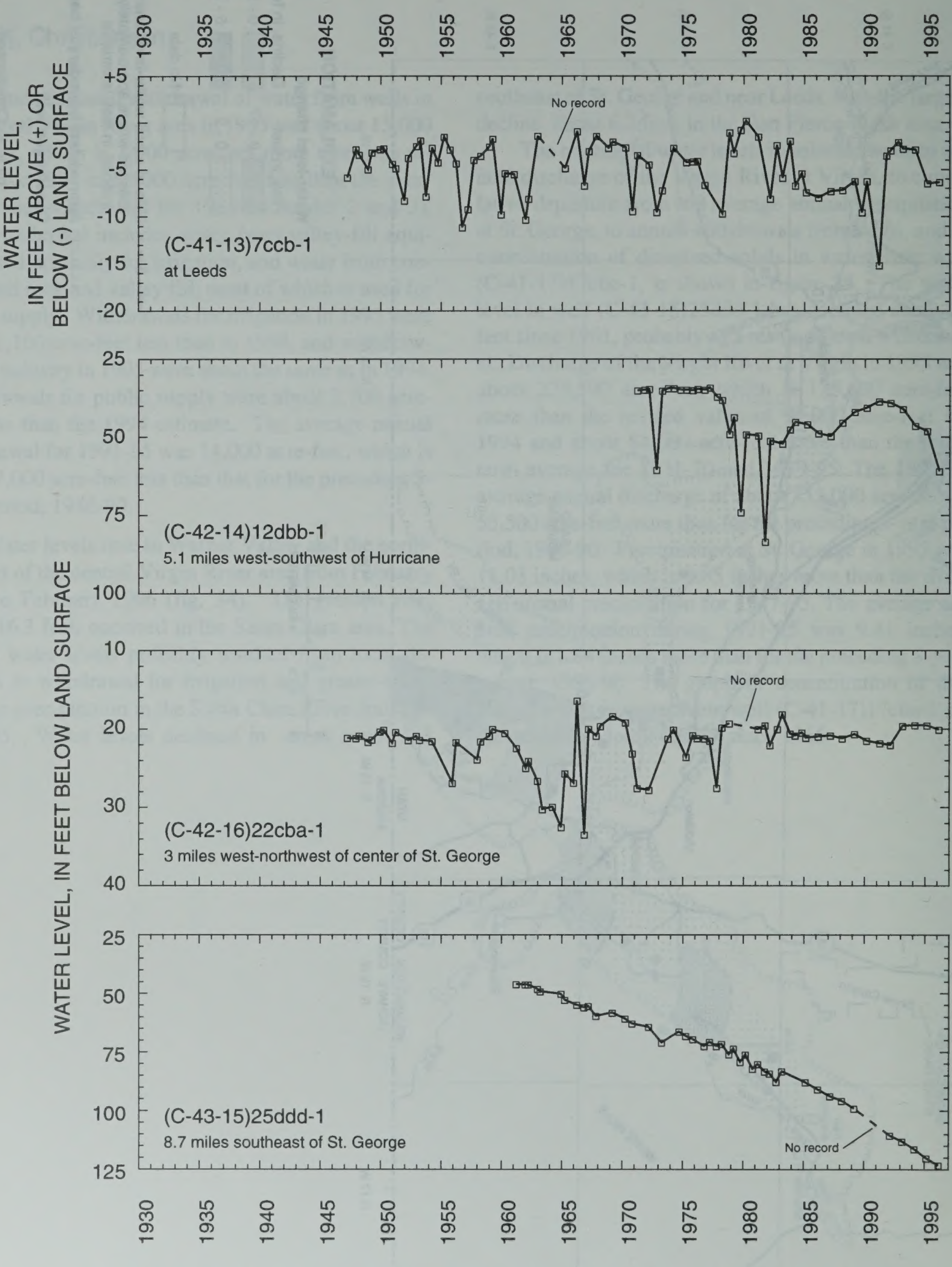


Figure 35. Relation of water levels in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1.

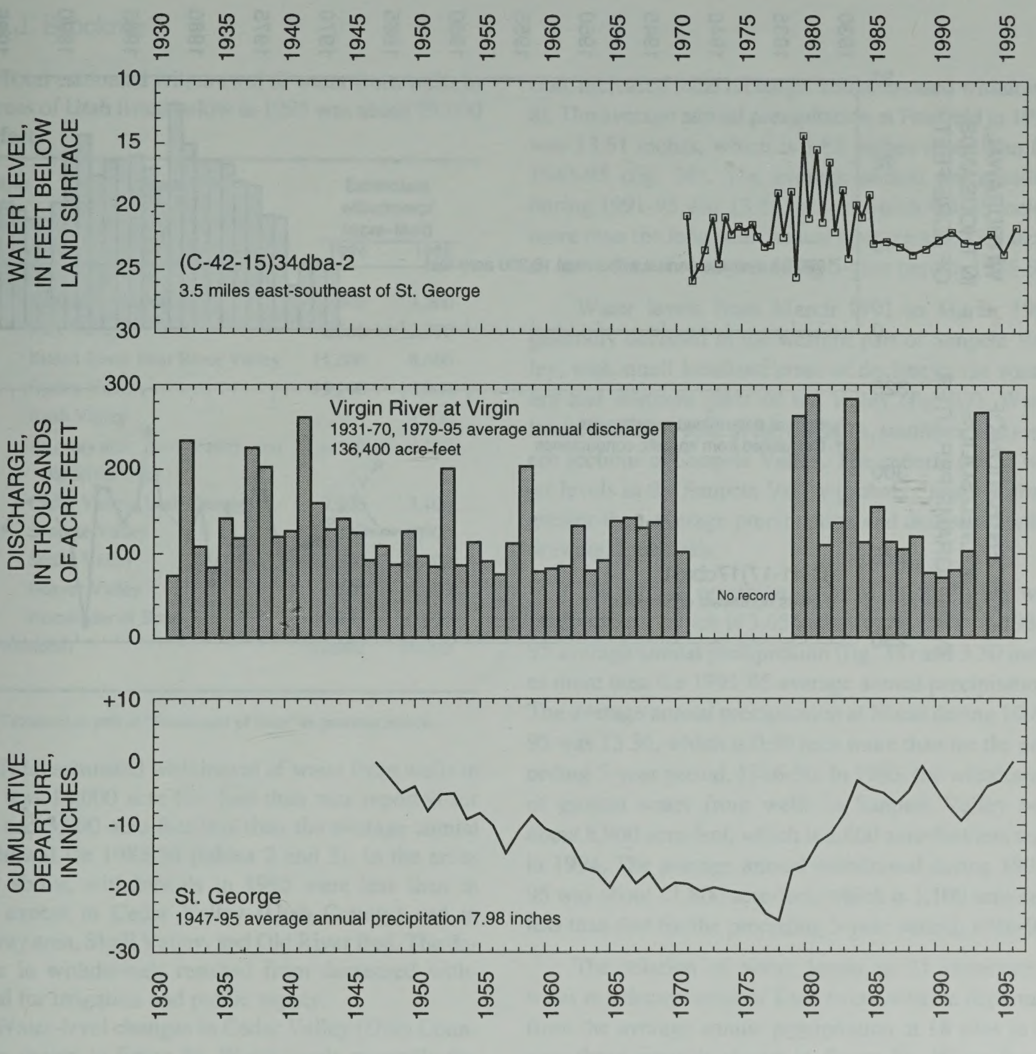


Figure 35. Relation of water levels in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

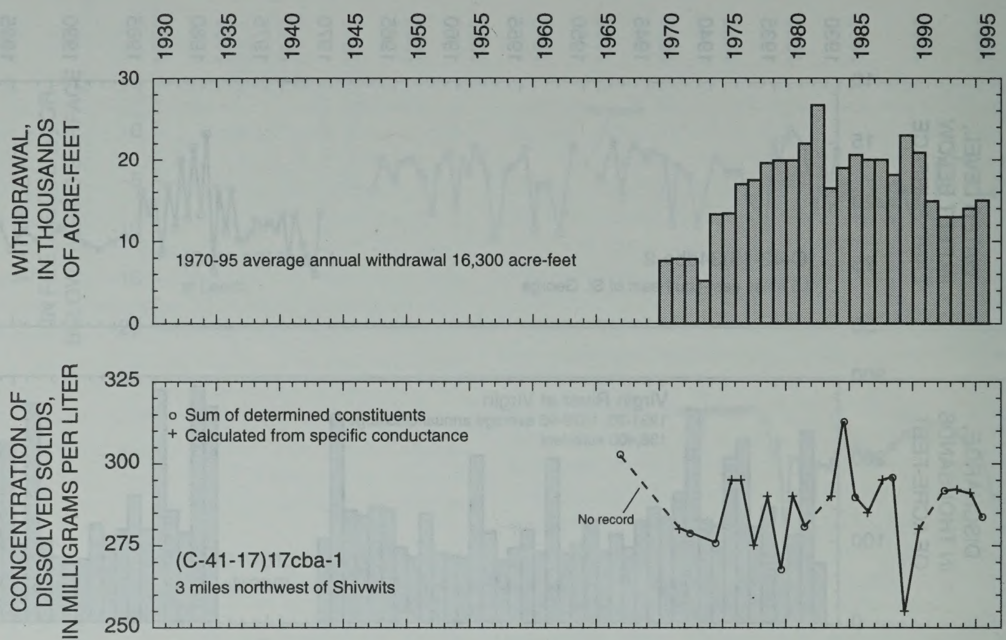


Figure 35. Relation of water levels in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

OTHER AREAS

By S.J. Brockner

Total estimated withdrawal of water from wells in the areas of Utah listed below in 1995 was about 95,000 acre-feet.

Number in figure 1	Area	Estimated withdrawal (acre-feet) 1994	1995
1	Grouse Creek Valley	3,900	3,200
2	Park Valley	2,600	2,100
4	Malad-lower Bear River Valley	11,800	8,600
8	Ogden Valley	13,100	13,000
13	Rush Valley	—[1]	3,200
14	Dugway area, Skull Valley, and Old River Bed	6,100	9,300
15	Cedar Valley, Utah County	2,900	3,100
20	Sanpete Valley	11,500	8,900
25	Snake Valley	13,500	6,600
27	Beaver Valley	7,700	6,700
	Remainder of State	40,200	30,000
Total (rounded)		113,000	95,000

[1]Tabulated as part of "Remainder of State" in previous reports.

Total estimated withdrawal of water from wells in 1995 was 18,000 acre-feet less than was reported for 1994 and 3,000 acre-feet less than the average annual withdrawal for 1985-94 (tables 2 and 3). In the areas listed above, withdrawals in 1995 were less than in 1994 except in Cedar Valley (Utah County) and in Dugway area, Skull Valley, and Old River Bed. The decrease in withdrawals resulted from decreased withdrawal for irrigation and public supply.

Water-level changes in Cedar Valley (Utah County) are shown in figure 36. Water levels generally declined from March 1991 to March 1996 in the northern half of Cedar Valley because of greater-than-average withdrawals from wells during 1991-95 as compared with those of the preceding 5-year period, 1986-90. The average annual withdrawal during 1991-95 was about 2,800 acre-feet, which is 400 acre-feet more than for the preceding 5-year period, 1986-90. Rises in water levels in the western and southern parts of the valley probably resulted from greater-than-average precipitation, increased local recharge, and decreased withdrawal. The average annual precipitation at Fairfield in 1995 was 13.61 inches, which is 1.91 inches more than for 1943-95 (fig. 38). The average annual precipitation during 1991-95 was 13.25 inches, which is 1.55 inches more than the long-term annual average and 3.09 inches more than for the preceding 5-year period, 1986-90.

Water levels from March 1991 to March 1996 generally declined in the western part of Sanpete Valley, with small localized areas of decline in the southern and northern parts of the valley (fig. 37). Water levels generally rose in the northern, southern, and eastern sections of Sanpete Valley. The general rise in water levels in the Sanpete Valley probably resulted from greater-than-average precipitation and decreased withdrawals from wells.

The annual precipitation at Manti for 1995 was 16.86 inches, which is 3.65 inches more than the 1935-95 average annual precipitation (fig. 38) and 3.50 inches more than the 1991-95 average annual precipitation. The average annual precipitation at Manti during 1991-95 was 13.36, which is 0.59 inch more than for the preceding 5-year period, 1986-90. In 1995, the withdrawal of ground water from wells in Sanpete Valley was about 8,900 acre-feet, which is 2,600 acre-feet less than in 1994. The average annual withdrawal during 1991-95 was about 11,800 acre-feet, which is 1,100 acre-feet less than that for the preceding 5-year period, 1986-90.

The relation of water levels in 21 observation wells in selected areas of Utah to cumulative departure from the average annual precipitation at 18 sites in or near those areas is shown in figure 38. Water levels from March 1991 and from April 1991 to March 1996 rose in 15 and declined in 5 of the 20 observation wells. From 1995 to 1996, water levels rose in 17 and declined in 4 of the 21 observation wells. The rises generally resulted from decreased withdrawals of water from wells during 1995 as compared with those during 1994 and 1991 (table 3). Average annual precipitation during 1991-95 was greater than for the preceding 5-year period, 1986-90, at 17 of the 18 precipitation sites.

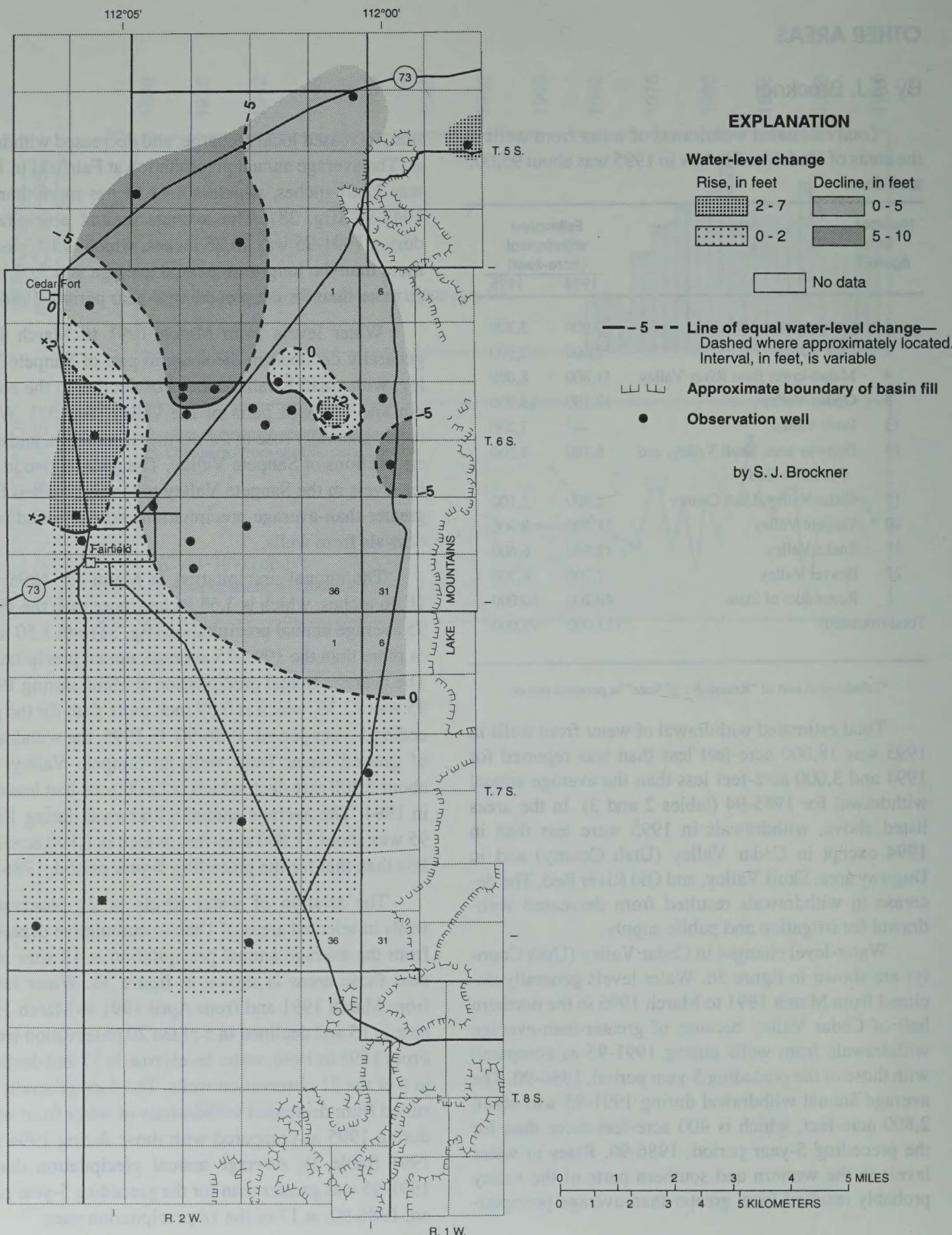


Figure 36. Map of Cedar Valley, Utah County, showing change of water levels from March 1991 to March 1996.

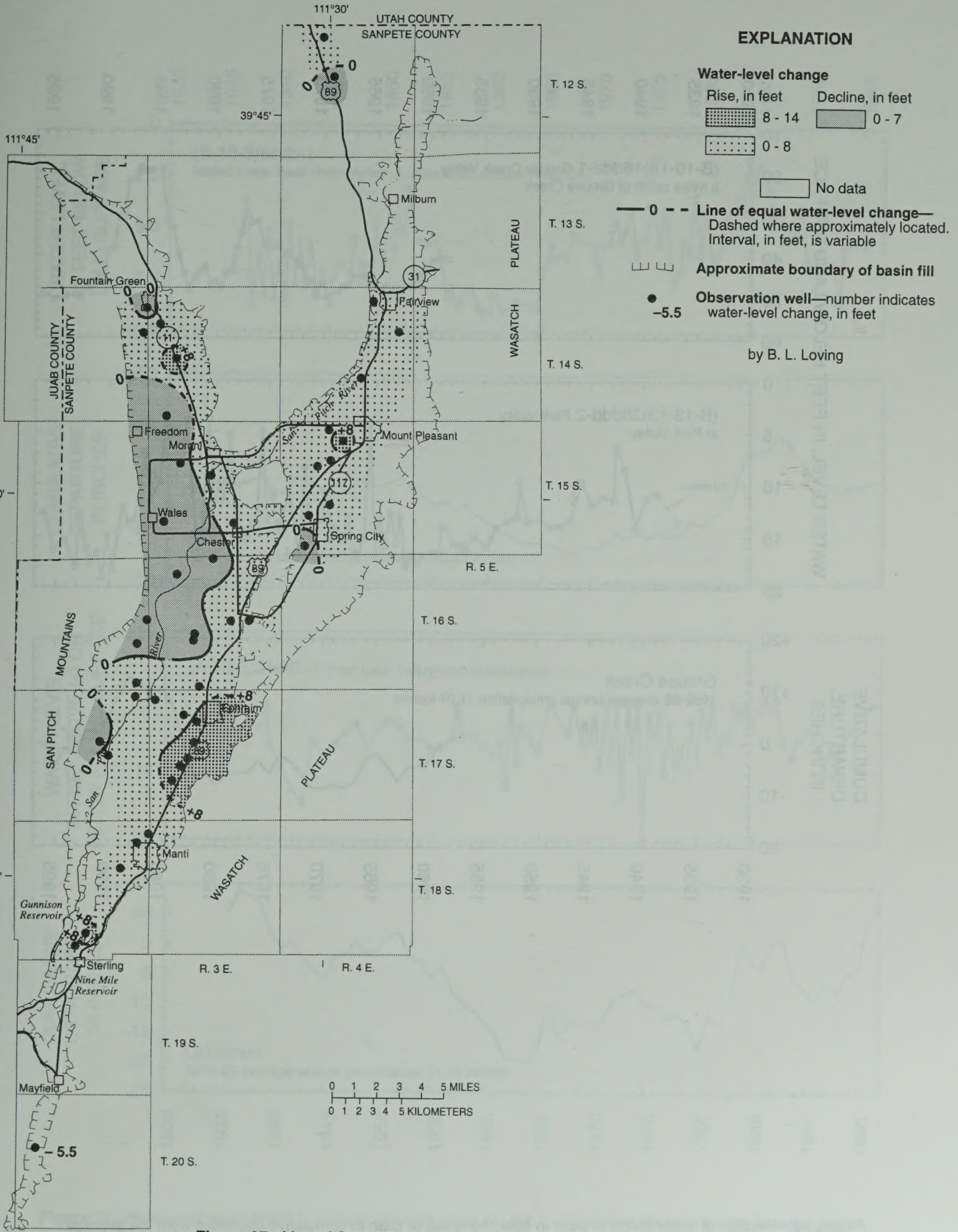


Figure 37. Map of Sanpete Valley showing change of water levels from March 1991 to March 1996.

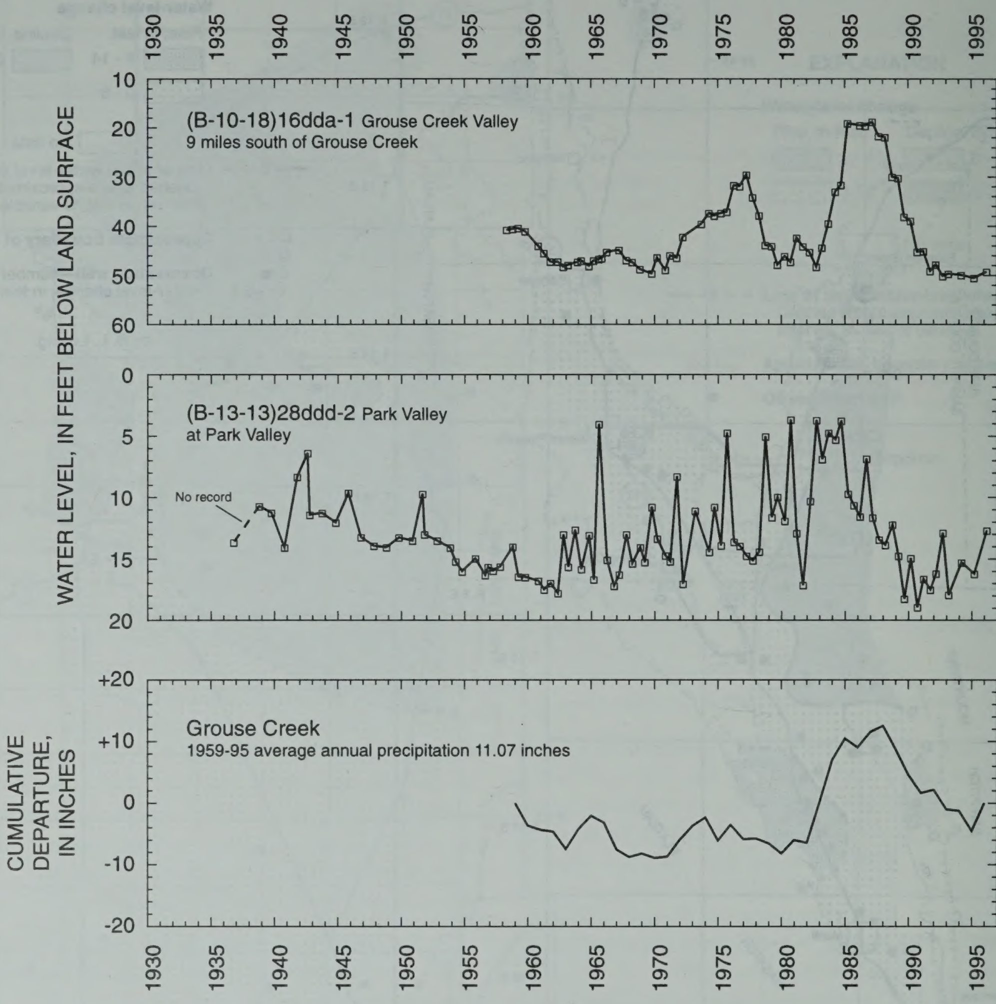


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

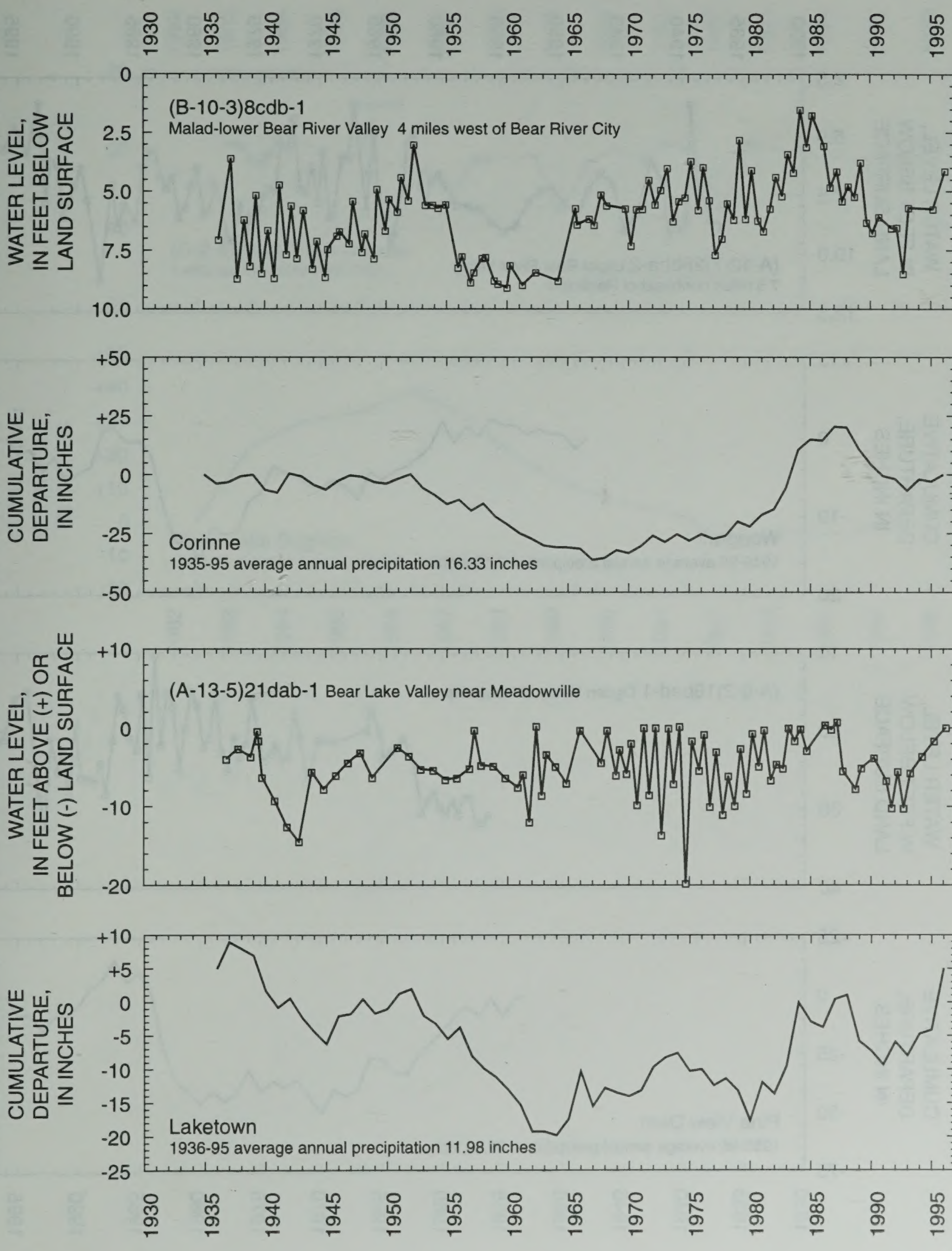


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

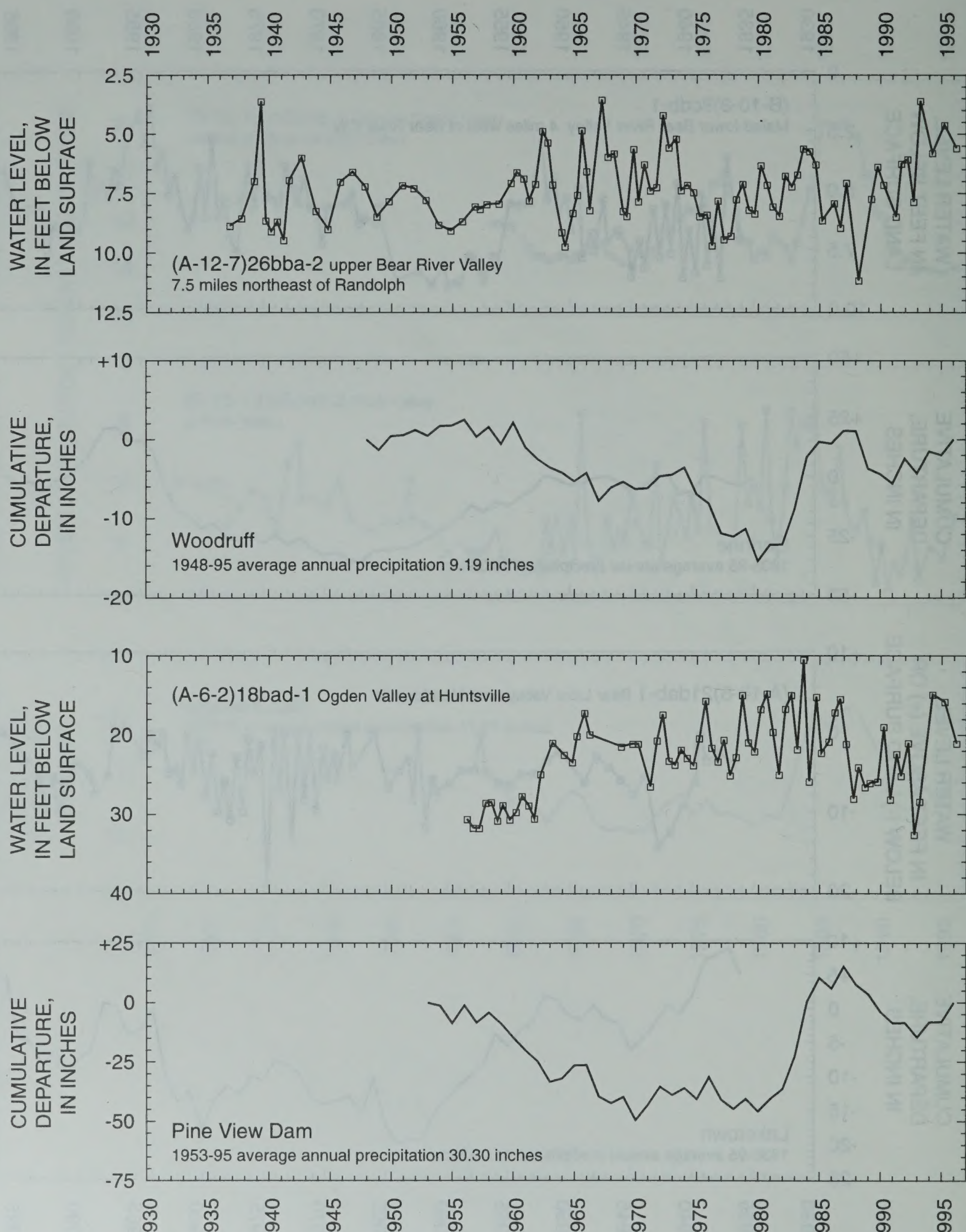


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

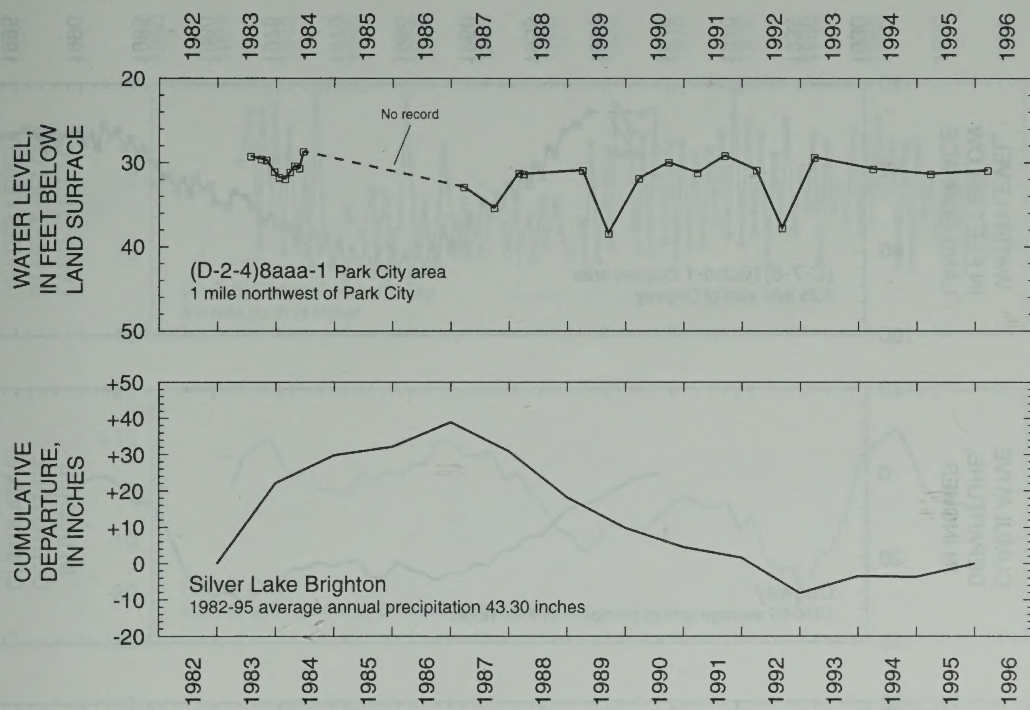


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

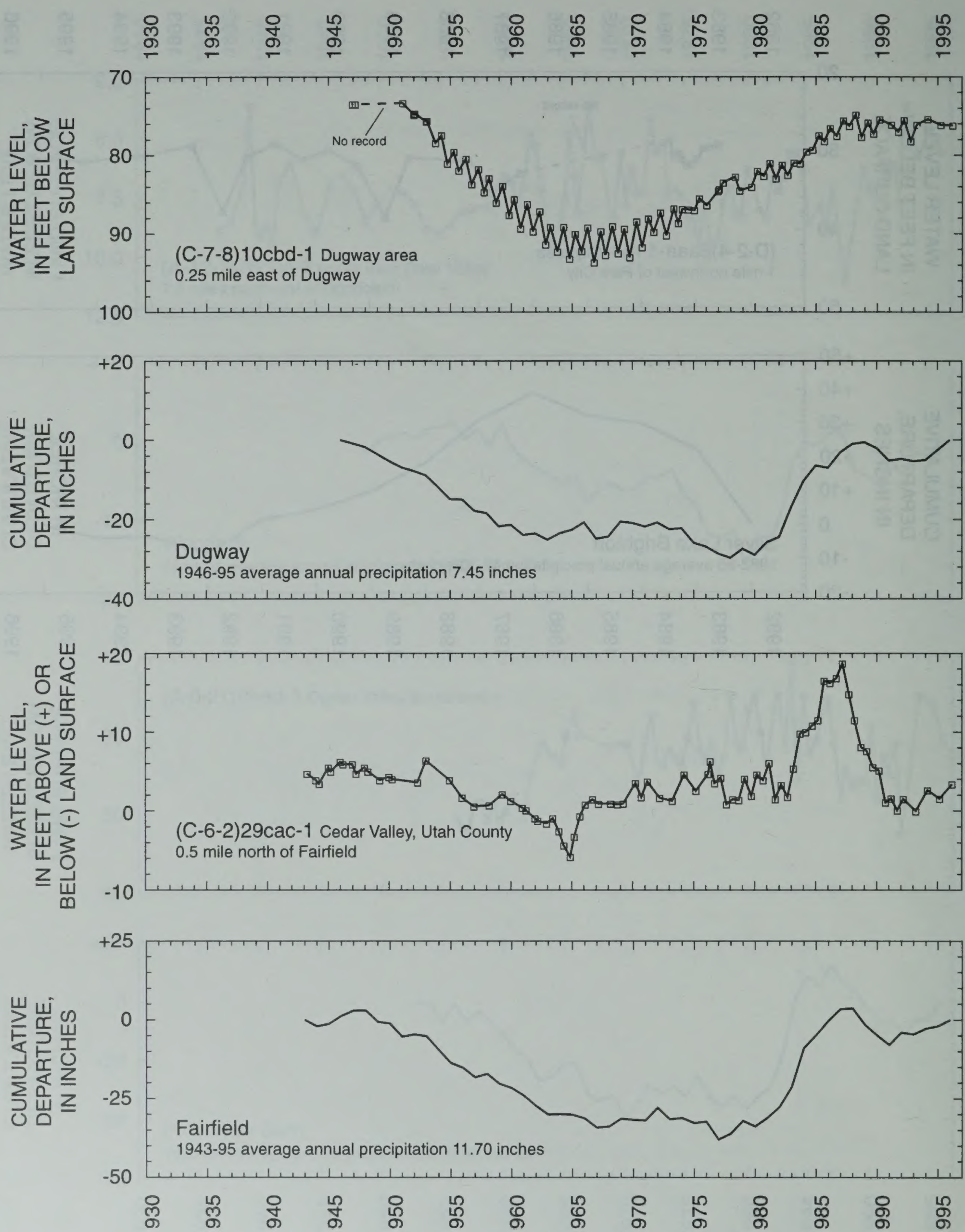


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

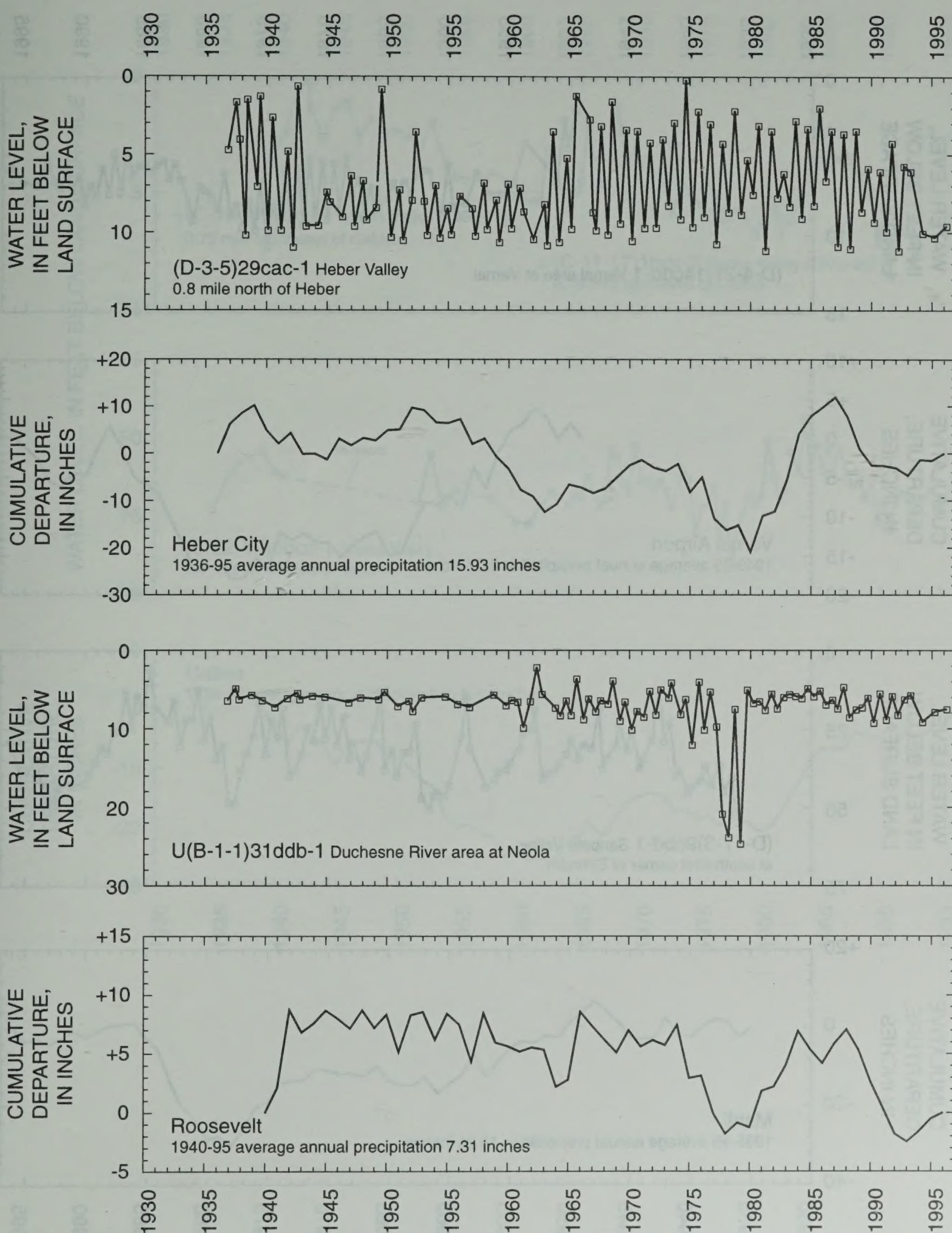


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

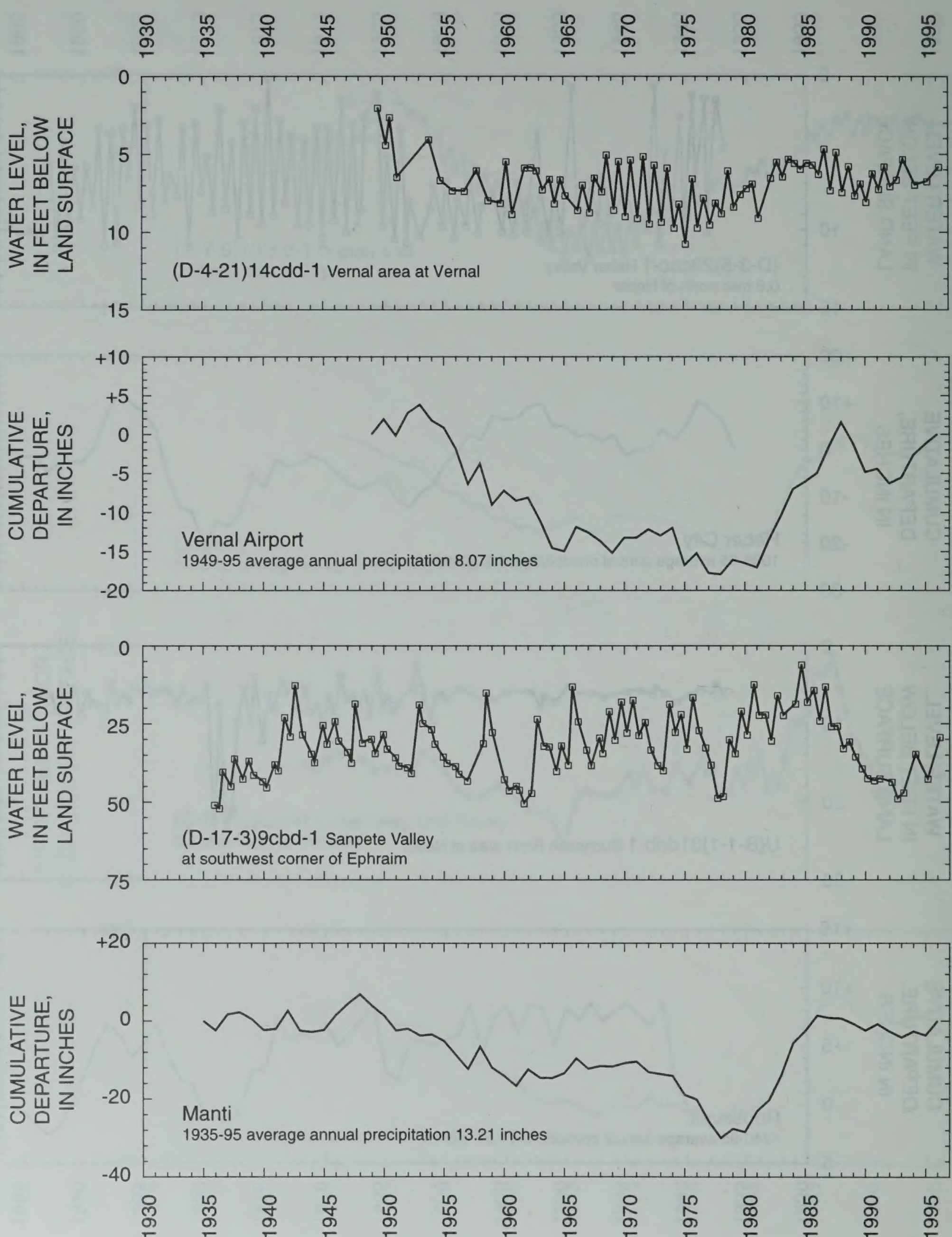


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

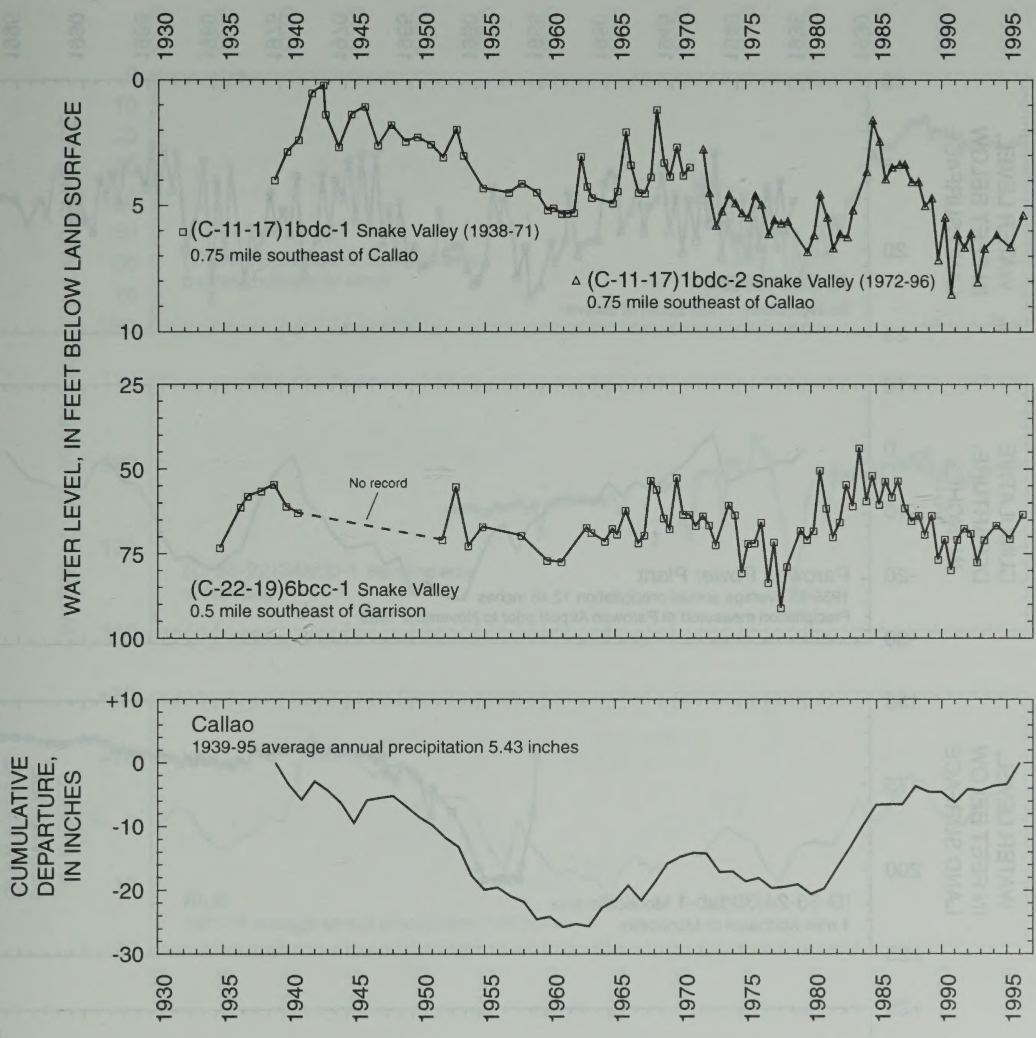


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

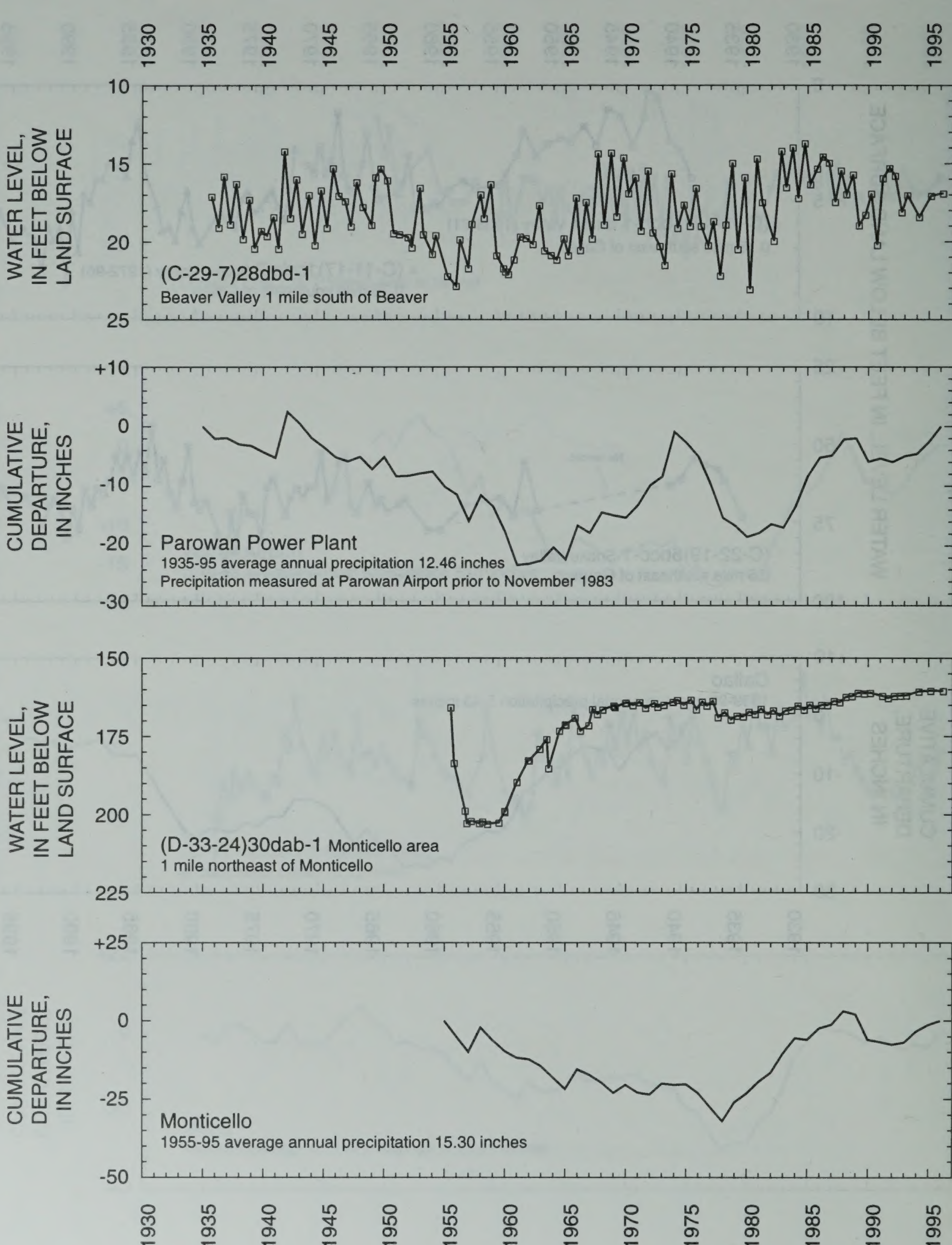


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

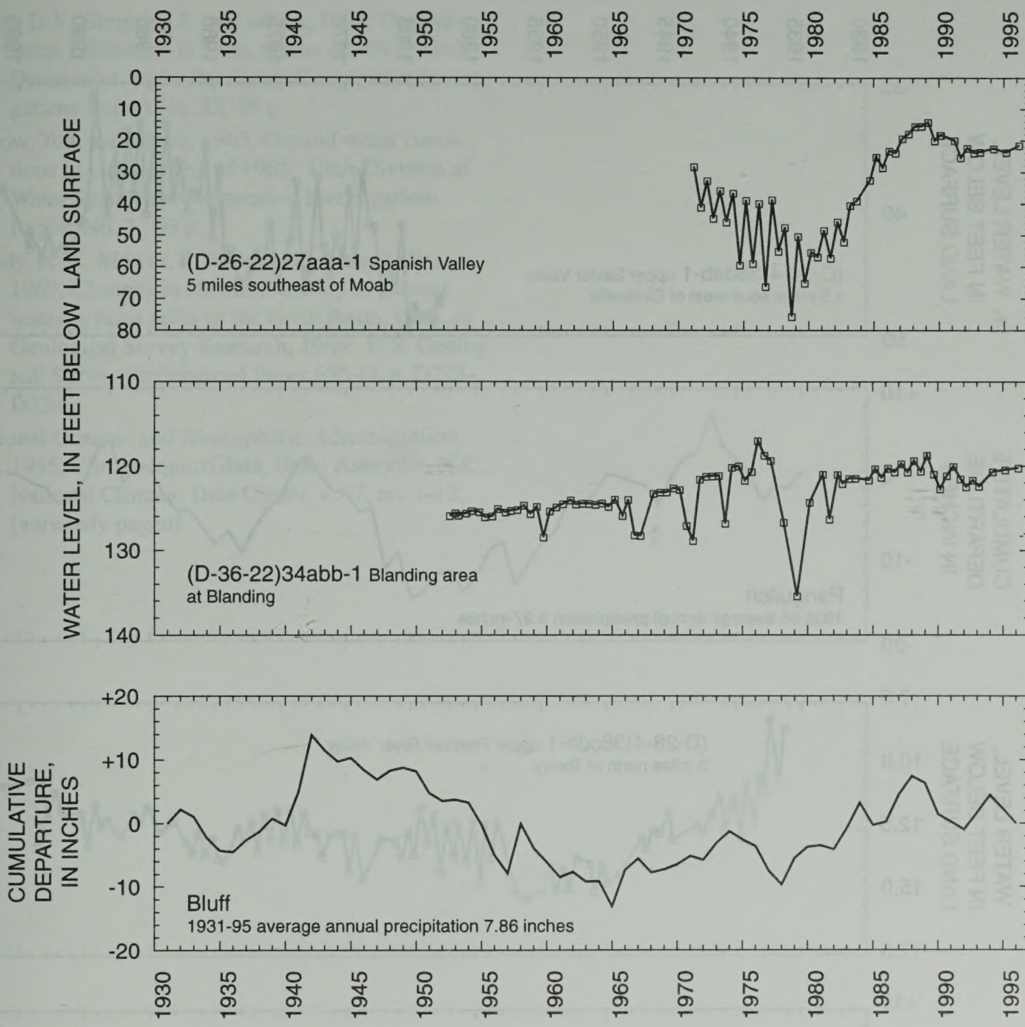


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

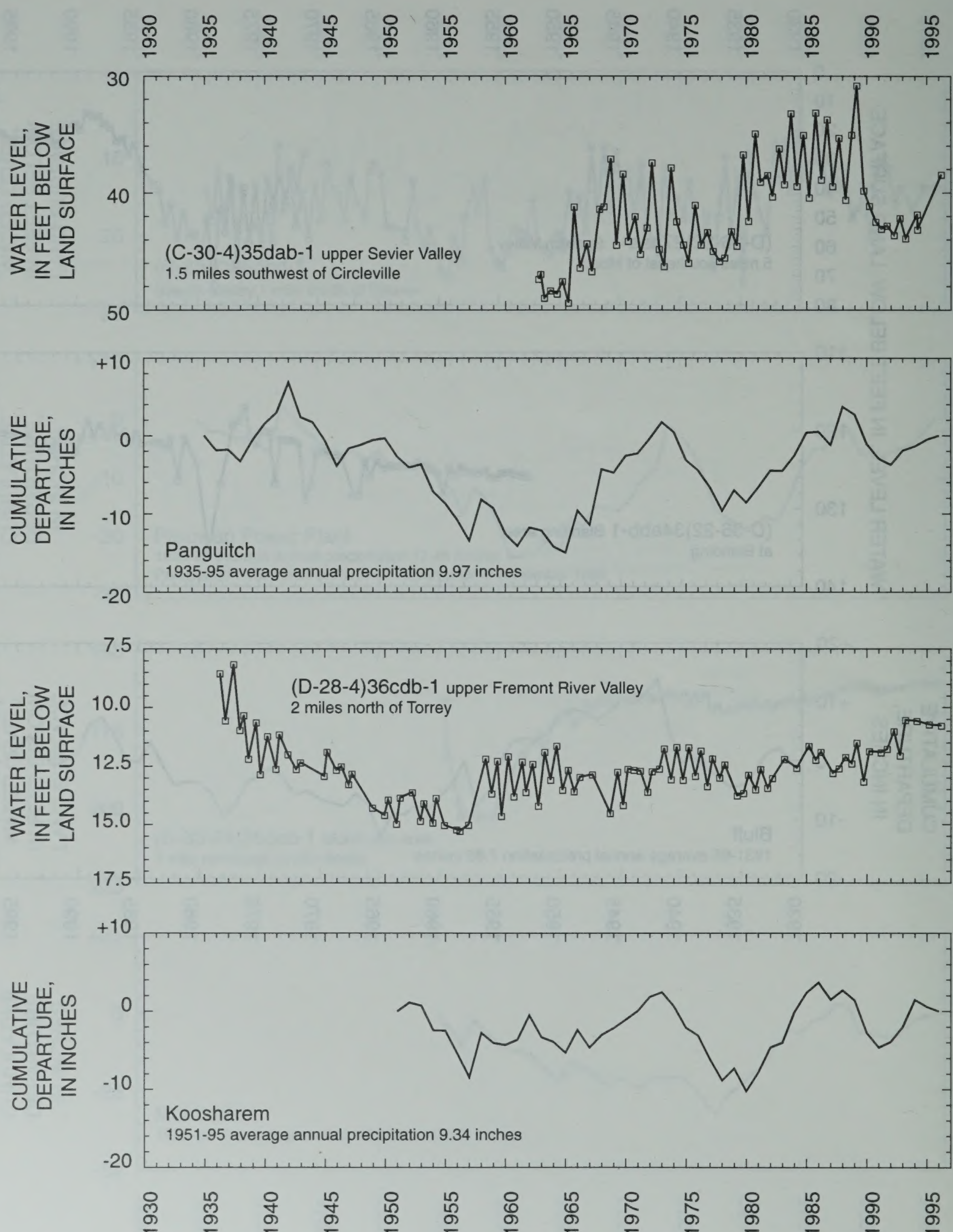


Figure 38. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

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